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OCTOBER, 1959

ADHESIVES AGE

MANUFACTURE, APPLICATION, TECHNOLOGY, RESEARCH AND MARKETING

A/A October Schedule

Polyvinyl Acetate Copolymers

Tack Article

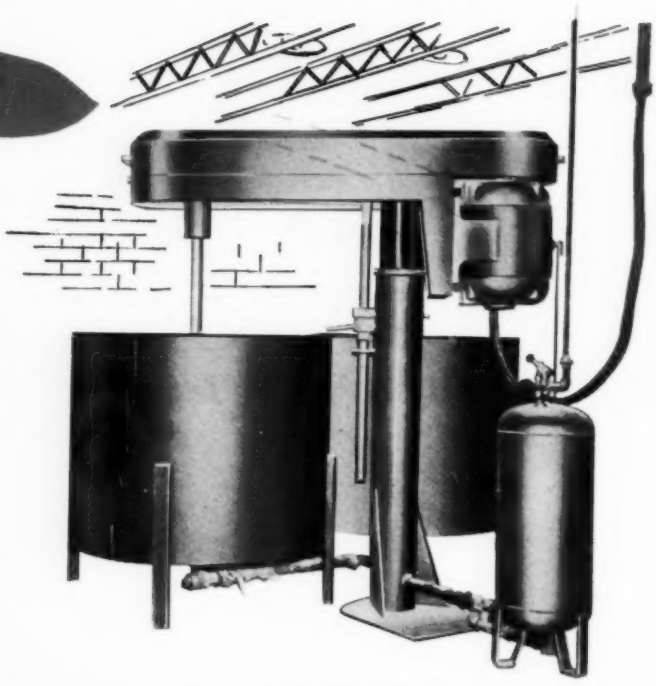
Epoxies and Motorboats

Adhesives in Displays

Sealing Tapes

Solvents

COWLES DISSOLVER processes 200,000 gals. per mo. of rug backing compound for Consolidated Latex Co.



Cowles Model 720 VH with dual tank setup provides practically continuous processing for Consolidated.

"... eliminated need for bulky, old-fashioned milling and mixing equipment — handles complete processing operation in one pass, in much less space, at less cost," reports William Stellings, President.

William Stellings, President, Consolidated Latex Co., Chattanooga, Tennessee.

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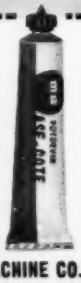

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ADHESIVES AGE

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About the Cover Design

This month's cover is our staff artist's rendition of the schedule board posted in the editorial offices of ADHESIVES AGE. The topics noted are covered in our current issue and are indicative of the wide range of interests involved in the adhesives industry.

The opinions expressed by authors and contributors to ADHESIVES AGE are not necessarily those of the editors or publisher. Articles appearing in ADHESIVES AGE may not be reproduced in whole or in part without the express permission of the publisher.

PALMERTON PUBLISHING CO., INC.

OCTOBER, 1959

VOL. 2 NO. 10

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RED STRIPE.....101-120 grams
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News about R&A SINCE 1913 **Adhesives**

FOR ALL METALS AND ALL PLASTICS

Speed production bonding with this 1-part "no-mix" paste epoxy

TECHNICAL DATA ON

Bond*master*® M620

A thixotropic, heat-curing (300°F or higher), 100%-reactive, *one-part* ("no-mix"), solvent-free formulated epoxy adhesive designed for bonding metals and rigid plastics as well as other rigid materials to themselves and to each other.

APPLICATION

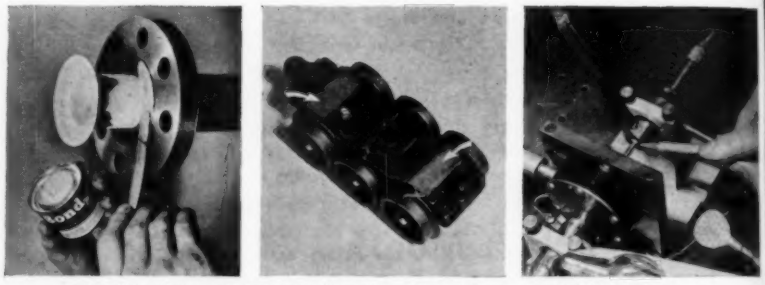
BONDMASTER M620 is soft and buttery, making it extremely easy to spread smoothly and evenly right from the container in which you receive it. Once applied, it maintains its form and DOES NOT FLOW during the curing cycle. Excellent for "poor fit" and similar void-filling applications as well as where dripping or running of adhesive cannot be tolerated.

BOND CHARACTERISTICS

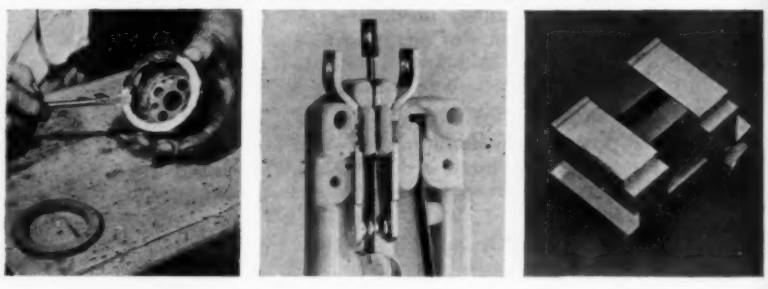
Fully-cured bonds exhibit minimal shrinkage, are electrical insulators, and provide excellent resistance to weather, galvanic action, and most chemicals, acids, and alkalies.

ALL METALS—ALMOST ALL PLASTICS

Current production usage of this formulation includes bonding: "Teflon" to steel, aluminum and other metals; phenolic to aluminum; diamonds to graphite; ceramic to steel; glass to brass; Alnico to aluminum and cast iron; carbide to steel; "Mycalex" to itself; aluminum to itself, to copper, steel, zinc die cast, magnesium, etc.; reinforced polyester fiberglas to itself and to various metals; stainless steel to bronze; rigid plastics to themselves and to various metals.



"Teflon" to steel . . . Alnico to zinc die cast . . . glass to brass . . . carbide to stainless . . . rigid plastic to copper . . . ceramic . . . stainless . . . cast iron . . . magnesium . . .



If the materials you work with can be heat-cured in the 300°F range (or higher), here's an unusual development in 100%-solids epoxy adhesives—BONDMASTER M620 — a unique *1-part* paste that can:

- give you high shear strength bonds between all metals and just about any plastics
- eliminate costly post-finishing (this paste won't flow or drip during cure!)
- permit the use of relatively unskilled labor on critical metal and plastics bonding jobs
- eliminate time-consuming weighing and mixing of separate components

—at a fraction of the cost-per-pound normally applying to 100%-reactive, heat-curing formulated epoxy adhesives.

NO MIXING

You can use this versatile formulation right from the can, just as you receive it. It not only spreads as easily as a heavy cold cream, but it's thixotropic, too . . . won't flow or drip during the cure, won't sag in *any* position.

MULTI-PURPOSE USE

Because BONDMASTER M620 offers outstanding speed and savings in the mass production bonding of a wide range of similar and dissimilar materials (see list in column on left), it is supplanting silver solder in some of the leading metalworking plants in America.

Write for Technical Data Sheet. (We will be glad to send a free evaluation sample as well if you will describe your bonding problem in detail.)

R&A SINCE 1913

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EDITORIAL

A/A = Catalytic Agent

While we would not suggest that ADHESIVES AGE is wholly responsible for the great upsurge in the adhesives market, we begin to have the undocumented impression that this publication is contributing to heightened activity in no small measure. Following the publication of our article "Adhesives in the Cosmetic Industry," for example, we learned of a number of companies who began an investigation of this market. Comments seemed to run in one general direction: "We are amazed that the cosmetics industry apparently consumes many, many pounds of adhesives a year . . . this is a whole new market!"

We have seen and heard other "unverified" evidences of the effect which this publication is having in the creation of new attitudes. Staff members in attendance at various gatherings about the country report that ADHESIVES AGE is frequently cited as a source for technical and market information. Our own Readers' Service Department reports ever-increasing requests for information, for reprints and for other data.

Above and beyond the initial distribution each article receives in ADHESIVES AGE, almost every editorial feature is reprinted (by request) with the end result that thousands of additional copies are circulated. Of course, we are enormously pleased by all this and we hope that we will be able to continue to offer comprehensive coverage of the industry.

It is in the area of marketing that we are particularly pleased with what this publication has been able to accomplish. One of the major tasks we set for ourselves in founding this journal was the opening of new markets. We believe that in the past year we have touched upon areas which have never been fully explored.

In essence, we like to feel that ADHESIVES AGE has become a catalytic agent for the entire adhesives industry prompting new approaches, new areas for investigation. All of this, naturally enough, places a continuing and growing obligation upon us. We mean to carry out this obligation with an increasing number of varied and pertinent editorial features. We hope to continue to grow with the industry we serve.

Have you an ADHESIVE PROBLEM?

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(Conforms to Government Specifications PPP-T-97-Type 11)

Write for full information on Mystik Super Flextron No. 6497 and other Mystik brand packaging tapes.

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MYSTIK BRAND TAPES
SELF-STIK

PROTECTIVE COVERING MATERIALS—TAPES THAT TALK

CONSULTANT'S CORNER

By Dr. Irving Skeist

Question: A two-headed problem is confronting us on a special fabric item. Cementing two pieces of fabric with a non-staining flexible bond is the first problem and the simplest. This can be a contact (one surface only) or thermal set. They must withstand commercial laundering, dry cleaning and ironing. It is a household item and there is no strain on the bond.

The most difficult part is that these fabrics may have to be separated later by solvent or other means that would not damage or discolor vat-dyed materials. The material might be cotton, wool or synthetic.

The ideal result would be no stain left by the cement or at least one that could be removed by a solvent. Your suggestions as to the proper adhesives, solvents and possible sources will be a great help to us.

Answer: If it were possible to insure that dry-cleaning would always be carried out with hydrocarbons such as Stoddard Solvent rather than with chlorinated hydrocarbons, then a nitrile rubber such as Hycar 1571, cured with sodium aluminate, might be applicable. The separation could then be accomplished with ethylene dichloride or methane.

Since you probably cannot control the dry-cleaning solvent, however, you should try bonding with an acrylate ester resin emulsion such as Rhoplex B-15, possibly fortifying it with some urea-formaldehyde resin such as Rhonite R-1 (Rohm and Haas). The acrylate resin is resistant to dry cleaning and moderately resistant to laundering, yet easily softened by acetone or methyl ethyl ketone. But the acrylate is thermoplastic, and the bond may become inadequate at ironing temperatures. Consequently the urea-formaldehyde resin is suggested to improve heat-resistance and launderability.

To the extent that the urea resin is used, it will make subsequent separation with ketones more difficult. Ketones are permissible on cotton, wool and most synthetics, but not on cellulose acetate rayon.

Q-113

Dr. Skeist is associated with Skeist & Schwarz Laboratories, Inc., 89 Lincoln Park, Newark 2, N.J. He is the author of the recently published book, "Epoxy Resins."

CONSULTANT'S CORNER

Readers who would like to contribute their own experience with problems similar to those discussed in Dr. Skeist's column are invited to write to ADHESIVES AGE, *101 West 31st Street, New York 1, New York. Please refer to the code number given at the end of each question and answer group.*

Question: Our company manufactures musical instruments. We contemplate making our drum heads from Mylar cemented to an aluminum hoop. The bond must be able to withstand the pressure required to tune the drums. Can you recommend an adhesive?

Answer: Many adhesives manufacturers have products for bonding polyester film to aluminum. These may be of three types:

(1) A cement based on nitrile type synthetic rubber compounded with phenolic resin.

(2) A high-impact-strength epoxy formulation, comprising liquid epoxy resin, powdered filler, and polyamide or aliphatic-modified polyamine curing agent. These adhesives are supplied in two components which are mixed just before using.

(3) A polyester dope, based on resin supplied by one of the manufacturers of polyester film.

Q-119

Question: We are developing a product line in which a sheet of decorated vinyl is pasted onto a wood surface. Several adhesives outfits have submitted samples that work pretty well as far as sticking is concerned, but after a while the vinyl starts to shrink and pull in, and the piece is ruined. Where can we get an adhesive that will not do this, or how can we mix one ourselves?

Answer: Your trouble may originate in the film rather than the adhesive. Vinyl chloride resins are formulated with *plasticizers* to make them flexible and workable. Most plasticizers are *monomeric*, which means that they are rather small molecules that *migrate* easily from the vinyl film to any adjacent layer in which they will be *compatible*. If the adhesive is suitable for bonding vinyl, it is perforce a composition in which the film plasticizer will be compatible. Dioctyl phthalate (DOP), the most widely used vinyl plasticizer, is monomeric and notorious for its tendency to migrate.

To avoid plasticizer migration, you must use film compounded with *polymeric plasticizers*. These are large molecules containing many repeat units, each of which is the size of a monomeric plasticizer. Because of their length, they tend to remain trapped in the vinyl film even when it is in contact with an adhesive which tries to lure them away. They are somewhat higher priced than the monomeric plasticizers, so you must expect to pay somewhat more for your vinyl film.

Q-121

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new adhesives

AND ADHESIVE PRODUCTS

Silicone Rubber Bondant

Designed for bonding RTV (room-temperature-vulcanizing) silicone rubber to metal, Adhesive EX-B579-1 is said to produce rubber-tearing bonds which have excellent environmental resistance to broad temperature conditions. This one-part, one-coat adhesive does not stain, states the manufacturer. Bonds are obtainable with a wide variety of RTV silicone rubbers to steel, aluminum, brass, copper and other metals as well as glass, porous ceramics, cured epoxies, phenolics and other resins, synthetic fabrics and treated teflon. The adhesive is said to be suited to the processing and performances standards of the electronics industry where RTV silicones are used for potting and insulating connectors and other components. Additional applications include aircraft gasketing and sealing. *Hughson Chemical Co.* **P-181**

Polystyrene Bondant

Polystyrene can be joined to polystyrene with Logo Adhesive R-703, a fast acting solvent-type bondant. Features of the material include both resistance to high humidity and frosting in the tray. The material is balanced to allow the plastic to lay down smoothly with a minimum of roughness, burring and blushing near the glued section. Its almost instantaneous set eliminates the need for fixtures or clamping devices except on very large and/or badly warped parts. *Logo Division, Bee Chemical Co.* **P-182**

Cellophane Tape

Extremely thin, Permacel 44 Clear Cellophane Tape is said to have high tensile strength and excellent edge tear resistance. The pressure-sensitive product is specially formulated for excellent adhesion to a variety of surfaces and good unwind characteristics. The backing is resistant to grease, oil and solvents. Permacel 44 is available in 1296-inch and 2592-inch lengths and a variety of widths. *Permacel.* **P-183**

Liquid Steel

A combination of atomized steel and bonding resins in a heavy body liquid form, Liquid Steel can be ap-

plied as it comes out of the tube. It is said to adhere permanently to all metals and to bond securely to concrete, fiberglass, wood and many types of wood laminates. After it has dried, it can be cut, filed, sanded or machined. It is non-rusting and is a non-conductor of electricity. The product dries to a very dark gray, but bronze, brass, copper, silver or aluminum effects can be obtained after it hardens by rubbing or burnishing the surface with a piece of the metal to be reproduced. It may also be painted over with enamels or lacquers. *Woodhill Chemical Co.* **P-184**

PVA Emulsion

Said to have excellent mechanical stability, good blocking resistance, freeze-thaw stability, and to be highly stable in dilution. Gelva TS-85 is a fine-particle polyvinyl acetate homo-polymer emulsion. It has an average particle size of 0.2-0.3 microns and an emulsion viscosity of 1400-1700 cps. at 55 per cent solids. Films are flexible at room temperature without the addition of plasticizer. Suggested uses include adhesives, paper coatings, textile finishes and surface coatings. *Shawinigan Resins Corp.* **P-185**

Vinyl-to-Metal Adhesive

Used as a thermosetting adhesive for laminating vinyl films and sheeting to such metals as steel and aluminum, C 680 is a compound which can also be employed as a thermosetting primer for plastisol coatings on steel and aluminum. A solvent-type coating, it can be applied by spray, knife or roller coater. It is resistant to acids, alkalies and plasticizer migration. After a coating is applied, the metal is passed through a suitable oven in which the solvent is evaporated and the coated metal maintained at 400°F. for two to three minutes. While at this temperature, the vinyl which is at room temperature is combined by passing it through suitable nip rolls with the hot adhesive coated metal. The combined sheet is immediately passed through a cold water bath to prevent blistering. *Gordon-Lacey Chemical Products Co., Inc.* **P-186**

Flooring Material

Fast-setting, Emeri-Epox combines graded emery aggregate and epoxy resin. It has no toxic fumes, and skin contact causes no ill effects, states the manufacturer. This floor surfacing and patching material can be used to top floors of concrete, wood, tile, brick, stone or metal. Waterproof, it is unharmed by freezing temperatures and is resistant to abrasion and chemicals. Available in gray, red and green, it will bond to any clean surface without the use of a primer or bond coat. *Walter Maguire Co., Inc.* **P-187**

Resin Base Glue

A water dispersed, aliphatic resin base material, Titebond Glue is ready to use and has a pH of 5.0, plus or minus 0.2. It has a freezing point of 30°F., a gel point above 144°F., and a working range of 50° to 100°F. According to the manufacturer, the glue, cream in color, will not craze with time under dry conditions, nor does it absorb nearly as much moisture in a wet atmosphere as does glue made with a high grade hot animal glue. The manufacturer claims that the glue's fine heat resistance and cold flow resistance makes better joints than many polyvinyl acetate glues. Since it is ready to use there is no mixing or heating or change in the glue due to heating and evaporation, the company states. *Franklin Glue Co.* **P-188**

whatever the job . . .

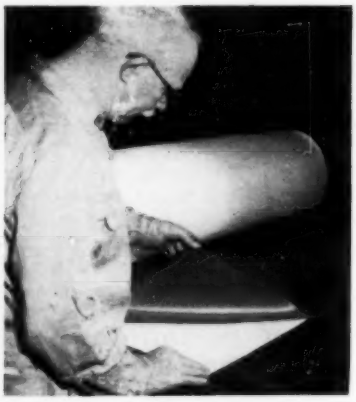
PERMACEL®
ADHESIVES

available only through jobbers —a complete line from pints to 55 gallon drums

PERMACEL *New Brunswick, N. J.* TAPES • ELECTRICAL INSULATING MATERIALS • ADHESIVES

Adhesive Sheeting

Armorline is an adhesive rubber sheeting which can be applied to metal, concrete, wood and other materials almost as easily as cold patch to an inner tube. A thin gauge of



tacky rubber is bonded to the bottom side of the material which is protected by a piece of removable Holland cloth. The abrasion-resistant material is designed for do-it-yourself covering of chutes and launders, or patching conveyor belt surfaces. The material is made from a rubber compound that is said to outwear steel of the same thickness. It is available in rolls 50 to 75 feet long, depending on the gauge of the material, and 48 inches wide. Gauges are 1/16, 1/8 and 1/4 inch thick; when a thickness above 1/4 inch is needed, the sheeting can be applied ply by ply to build up the required gauge. *B. F. Goodrich Co.* **P-189**

Vinyl Cements

Fast softening and fusing action between flexible and rigid vinyls, or vinyls and acrylics, is said to be available with two new vinyl plastic cements. Designated as VC-1 and VC-2, the cements are water white formulations. VC-1 is free flowing to make it particularly suitable for soak method application by felt pad contact in shallow pans. VC-2 is heavier bodied for simple brush use in joining flexible vinyls, including those of irregular shape. *Schwartz Chemical Co., Inc.* **P-190**

Nylon Strip Adhesive

Oriented nylon strip can be bonded to neoprene with Reevestrip Adhesive. It is also suitable for bonding nylon strip to nylon strip. *Reeves Brothers, Inc.* **P-191**

Tile Adhesive

Basically, TEC Cement-Set is a blend of Portland cement, fine sand and chemicals. It is available in two colors. The gray variety is designed primarily for use with vitreous ceiling and floor tiles; it has a short open time. The white Cement-Set has two to three times as much open time and is primarily used with wall tiles where more adjustment time is desirable. The product has no odor, will not burn, is non-staining, and is easily cleaned from tools, hands and the surface of the tile. Initial set takes place in from two to eight hours. Cement-Set is supplied as a powder and mixed with ordinary tap water for use. Its companion product is TEC Sno-Brite Dry-Tile Grout, also supplied in powder form. *Technical Adhesives, Inc.* **P-192**

Heat Transfer Cement

An inorganic cement with highly efficient heat transfer characteristics, Thermon is supplied in ready-to-use paste form for application over either conventional steam traced or electrical resistance systems. When cured to a cement-like hardness, it bonds itself to the coils and equipment. Features include excellent mechanical and thermal shock resistance; linear shrinkage is less than one per cent. The product is available in two grades: Standard Thermon can be used in both heating and cooling operations, or in applications requiring alternate heating and cooling; Thermon T-3 has a much finer granular structure and contains a retardant which lengthens its setting time so that a fairly large surface can be covered in one application. *Thermon Mfg. Co.* **P-193**

Elastomer Seal

Used in seal and liner applications, Fluorel elastomer is designed for use at 400°F., and chemically resists such fluids as diester, silicate ester, and petroleum based lubricants and hydraulic fluids. A highly fluorinated synthetic elastomer, it is not combustible due to high fluorine content. Results of test made by the manufacturer indicate that material undergoes no change in physical properties following one year of outdoor exposure in industrial atmosphere. It also does not crack after 200 hours of exposure to ozone at 150 ppm by the bent-loop method. The material is available in 1, 5 and 10 pound units. *Minnesota Mining & Mfg. Co.* **P-194**

All-Purpose Cement

Flexible curing-type bonds on leather or all types of composition soles, as well as leather or fabric uppers, can be produced with Be Be Weld, an all-purpose weather-resist-

ant cement. It flows easily at from 0° to 110°F., and soles can be attached without a press from one half hour to three hours after cementing. No reactivation is necessary. *United Shoe Machinery Corp.* **P-195**

Epoxy Resin System

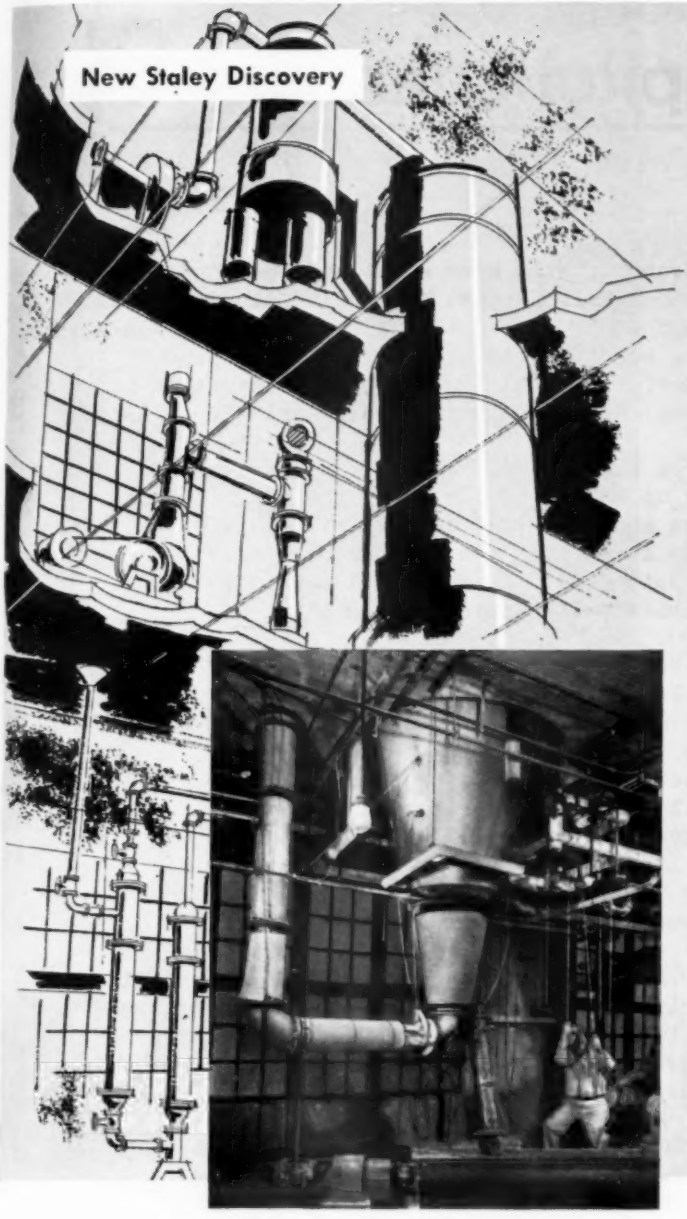
Development of an epoxy resin system to laminate safety panels directly to the face of television picture tubes is expected to provide increased flexibility in television set and tube design. The laminated tubes also provide the viewer with high safety protection and sharper image on the screen. The laminate material is a fast setting, pale liquid epoxy, and it is reported that the laminated assemblies withstood rugged heat and impact tests. *Dow Chemical Co.* **P-196**

Aluminum Cement

Metalset A-4 is an epoxy resin aluminum cement sold in self-metering tubes. A working supply of the cement is formulated by mixing equal amounts from the tubes "A" and "B" supplied. The epoxy compound can be used to smooth, fill or bond metal surfaces, or to fill seams, cracks or holes in wood and metals. *Smooth-On Mfg. Co.* **P-197**

Flooring Adhesive

Amtico Care-Free On-and-Below Grade Adhesive is designed for the installation of vinyl flooring over concrete on or below grade. No special floor preparation or underlay is needed. *American Biltrite Rubber Co.* **P-198**



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WHAT WILL 1960 BE LIKE? Economists in government and in industry are taking first looks these days, to help with budgeting and in sales planning. They see a record year for business coming up in 1960. In a nutshell, it will be a year of above-average growth, an extension of today's solid upturn. In the coming year, there'll be less of the usual headaches that go with a brisk boom. Price stability, for example, will be a prime characteristic of 1960.

Main strength will come from the economy's private sectors. Government outlays will go up only slightly. But spending by business for inventories and new plant construction will rise substantially. At the same time, consumer expenditures will keep expanding at a rapid clip. Durables sales will be making big gains. Nondurables will keep on rising steadily.

Here's what the basic indicators will look like in 1960:

- Gross National Product will rise 5-6%, to about $515 billion.
- Industrial output will go up 4-5%. It's rising 14% this year.
- Employment will rise more than the normal gain of 800,000 in the labor force. It could top 69 million some months.
- Unemployment probably will drop below the 3 million level.
- Corporate profits will exceed 1959's $52 billion by 10%.
- Wage hikes may match the 10¢-an-hour pattern for this year.
- Personal income will rise 5% to $400 billion. Since prices will rise only 1%, this means a solid gain in buying power.

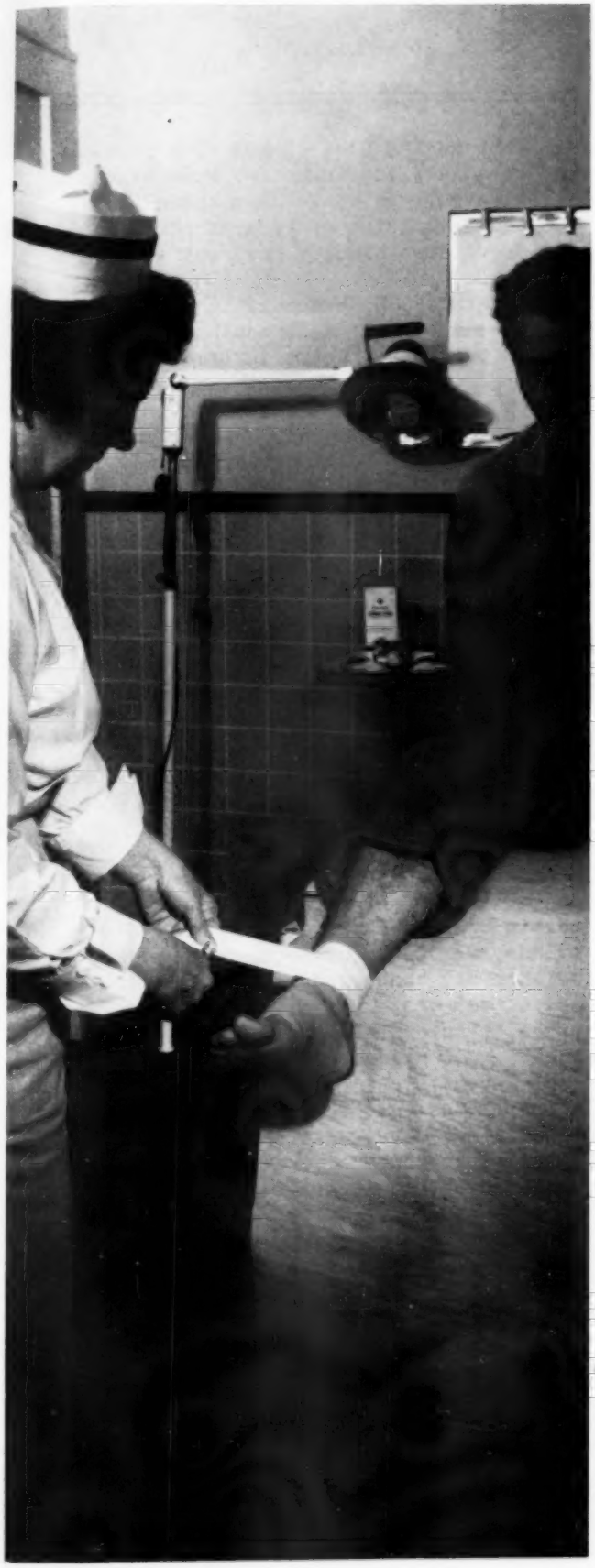
FEAR OF INFLATION SEEMS TO BE ABATING these days. Officials still warn the U.S. to hold the wage-price line. But businessmen and investors seem less pessimistic. They are impressed by expert forecasts that prices will only rise 1% or so in the next year—less than half the rate of recent years. This helps to explain some of the stock market's recent lapses.

AUTO SALES WILL TOP 7¼ MILLION IN 1960—a new record. Volume will be boosted by rising confidence, rising incomes, and the new small models. And good auto business will help assure a good year for business generally. For domestic manufacturers, alone, 1960 will be the second best year. The foreign makes will grab 600,000 sales, up from little in '55, peak to date.

RETAIL SALES WILL SET RECORDS THIS FALL—despite the impact of the steel strike. Economists base this forecast on the fact that consumers will have 5-6% more to spend than during the same period of last year; further, surveys show that they are in a buying mood. Volume this Fall may be up 8% over Fall '58, continuing the year's trend. Durables will be very strong.

Here's the sales pattern likely during the rest of 1959:

- Autos will rise about 20% over a year ago. The new, smaller cars will help to get the new model year off to a big start.
- Appliances and TV will see the Summer pick-up continue at a level 10% or 12% over last year. Radios will do well, too.
- Apparel will show good gains. Women's and children's lines should top 1958 by 10%. Men's clothing may benefit from the new medium-weight lines. Textile mills see good business.



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Schenectady manufactures the most complete line of resins for adhesives in the industry. Phenolics, modified-phenolics, terpenes and terpene phenols all are available and in commercial use. Whatever your adhesive resin requirement, your Schenectady technical representative is ready to help. Why not call him today or write Schenectady Varnish Company, Inc., Dept. 92-1, Schenectady 1, N. Y.

SHOE SOLE ADHESIVES containing Schenectady phenolic resins have excellent cohesion and adhesion. Tack-free at room temperature toward other materials, they simplify handling, speed production.

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capitol cues (con't)

THE NATION'S SUPERHIGHWAY PROGRAM WILL SHRINK SOME 15-20% as a result of Congress' refusal to vote all of the extra gasoline taxes the President wanted. Spending depends on the taxes collected. It would have taken all of the 1½¢ a gallon boost Ike wanted to keep work going at today's rate. With Congress unwilling to go above 1¢, some states already have cut work.

A DROP IN HOUSING STARTS WILL GET STARTED SOON, probably in the Fall. Principal reason is a tightening in mortgage money. In past months, interest rates on mortgages have gone up ¼ to ½ of a percentage point in some areas. More and more mortgages are being closed at over 6% in the West and Southwest. Advance loan commitments, made when money was easier, have kept activity high through the Summer. But a decline of 5% to 10% during fourth quarter is nearly certain now. The really big impact, though, will be felt next Spring.

PRODUCTIVITY IN MANUFACTURING ISN'T RISING as rapidly these days as it did the past year. Calculations based on government data show that for all workers in manufacturing, the rise in output per man-hour in the second quarter was at an annual rate of 6.8%, compared with 7.4% for the past year.

For production workers alone, the second quarter climb was 3.6%, compared with 4.7% in the past year. A slower rate of rise is usual at this stage of a cycle. The big gains come usually when business is first recovering from a recession.

SPECTACULAR GROWTH INDUSTRIES OF TODAY are spotlighted in a new study by the Department of Commerce. The findings should interest investors. The growth products or industries are defined as those expanding over 7½% a year.

Here's a partial listing of the fastest-growing products:

- Fastest growers—those expanding 40% a year or more—include transistors, antibiotics, synthetic rubber, TV sets, vitamins, plastics, helicopters, polyethylene, and titanium sponge.
- Between 30% and 40% are air-freight, air conditioners, tape recorders, automatic coffee makers, carpets, dryers, and Argon.
- From 20% to 30%, you'll find wines, tractors, jet fuel, air passenger travel, electric blankets, and nylon tire cord.
- From 15% to 20%, there are diesel locomotives, paper cartons for milk, distilled spirits, frozen foods, and food mixers.
- Between 10% and 15%, the study lists freezers, civil aircraft, aluminum, plywood, beer, garden tractors, clocks, transparent film for packing, sulfa drugs, dishwashers, and aviation gas.

MORE HELP ON SELLING TO THE U. S. GOVERNMENT is now being provided by the General Services Administration. The agency is preparing a master list of bidding opportunities. The items covered will be mainly supplies for civilian agencies for which GSA does most of the procuring. If you would like to get on GSA's mailing list, write for "Current Business Opportunities Releases," to GSA's Procurement and Business Services Division, GSA, Washington 25, D.C.

The GSA also is preparing to give small businessmen a break on sales of surplus property by breaking up items to be sold into smaller lots. This will make it easier for small bidders to buy. To find out more, write for "Guide Information For Surplus Buyers," GSA Sales Division, Washington 25, D.C.

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- a high-melting thermoplastic.
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- dark colored, friable.
- substantially insoluble in aliphatic hydrocarbons.
- compatible with a wide range of resins and plasticizers.

Typical Properties

Melting Point (ring and ball)	112°C.
Acid Number	94
Gasoline Insoluble	83%
Oxygen Absorption	0.25%

Available in lump, flake, pulverized, and emulsion forms—as well as powdered sodium soap—Vinsol is finding ever-increasing use in industry. Further technical data is available from Hercules.

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• Figures published by the English Board of Trade show that sales of plastic materials increased slowly in the first quarter of this year compared with last year. However, it looks as though production of thermoplastics has reached a new record level as stocks are recorded as having increased appreciably. Exports of all types of plastic materials during the first quarter of this year amounted to 32,800 tons, approximately 18 per cent more than last year.

• Chemical Products Committee of the OEEC, which met in Paris recently, has predicted further expansion in the fields of plastics, petroleum chemicals and dyestuffs for 1959 to 1960. Two more countries, Belgium and Denmark, began producing petroleum chemicals in 1958. Investment is expected to rise even more rapidly to more than $1,600 million by the end of 1961, when another country, Austria, will have set up a petroleum chemical industry.

Total carbon content of petroleum chemicals produced in member countries rose from 630,000 tons in 1957 to 813,000 tons in 1958 and is expected to increase by more than 50 per cent to 1,225,000 tons in 1959. This growing level of production will require five million tons of liquid or gaseous feedstock. Products in which output will be appreciably expanded include synthetic rubbers of various types, and plastic materials, consisting mainly of polyethylene and polypropylene, ethylene oxide derivatives and solvents. The rate of expansion in the plastic materials industries was slightly lower in 1958 than previously, but in view of the large investments made, it seems likely that output will continue to expand.

• The United States government is increasing its effort to end the discrimination against United States exports, which is still practiced by many foreign countries that are no longer short of dollars. The practice of treating dollar goods less favorably than other goods, through special quotas and exchange controls, is a hangover from the days of the dollar shortage. Washington believes that equal trade treatment for dollar goods will give a real lift to United States exports and will help to cut the deficit in the balance of our payments. Administration officials also believe that it will reduce the growing pressure in Congress for higher tariffs and less foreign aid.

The government will press for action on this issue at the annual meeting of the International Monetary Fund. The issue will be followed up at the conference with GATT (General Agreement on Trade and Tariffs), which will be held in Tokyo during October.

• A European proverb states that domestic business provides bread, whereas export business supplies butter on toast. For this reason, many European companies are anxious to maintain a check on their export efforts and to try to improve every phase of them. Recently, we had an opportunity to obtain some field reports covering the export efforts of the adhesives industry and they indicated that American companies do not put enough energy into efforts to increase export business.

A leading American factory has entrusted a worldwide organization with its representation in various export markets. Inquiries directed to the respective representatives in Switzerland and other European countries produced either no results or very delayed reactions. Many inquiries were made for an American adhesive as the result of the appearance of a feature article in one of the leading German trade papers. All of these inquiries were directed to the American headquarters because at this time, there was no German representative. We have been told that a number of German companies which were interested in this adhesive complained that it took a very long time before requests were answered.

It seems that a number of American companies prefer to entrust their export business to American exporting companies or special organizations. In many instances, there have been complaints about the fact that the exporter, having very little interest in a particular product, does not do justice to the American product. Inquiries are not answered at all, answers are received late, or the answers do not contain all the requested information. In many cases, business possibilities are lost by the indifferent manner in which inquiries are handled.

It might be a good idea for management in American companies to investigate the handling of export inquiries. Although domestic business might be excellent and produce enough revenue, it is also imperative to go out and look and fight for the addtional export business which will represent, in any case, "butter on the toast" and in a small way will improve our trade deficit.

On the Continent

• At the Plastics Convention, held in London a few months ago, Dr. Kraft, who spoke for West Germany, pointed out that some work in the field of glass-reinforced plastics had been done as far back as 1930. Important developments were first made in the early part of this decade. Much of this progress was based on United States experience. In fact, a rather special situation existed in West Germany in that only two companies were operating in this sphere and their work was based on licenses granted by a United States firm.

Polyester resins dominated and epoxides were used only when polyesters proved to be inadequate. Some melamine was used with glass fiber and silicone resins were utilized only in those special instances in which their very high cost was justified. In 1957, the West Germans produced about 3,000 tons of glass-reinforced plastics and are expected to produce 5,000 tons in 1959. These figures are quite small when viewed against gross plastics output.

Glass fiber was used in the various conventional forms and raw materials for the polyesters were also usual. Styrene was employed almost exclusively as the cross-linking agent. Dr. Kraft described some standard tests for non-flammability which seemed very stringent to some of the audience.

• Pipe-line fever has gripped West European industrialists as they see oil products taking over more of Europe's fuel market. The current arena for pipe-line builders is southern Germany. High fuel prices there have attracted four groups which are eager to build pipe-lines from the Mediterranean to Bavaria. Demand is not likely to support more than one pipe-line, so pipe-line promoters are jockeying for position.

• International Latex Corp. sees an expanding market for girdles in West Germany, where it has set up a new subsidiary with 100 workers. The company estimates that the average West German woman buys one girdle every two years, compared with the average American woman's three girdles each year. International Latex expects to have 1,000 workers making girdles there within four years.

• Exhibition mania is the topic of an editorial in *Rubber Journal and International Plastics*. The editor points out that the world has been riding on the crest of an exhibition wave, particularly since World War II. The number of prominent international exhibitions of all types or national fairs with an international flavor will top the four figure mark in 1959.

In Britain alone, there were 99 large exhibitions of all types in 1950, and by 1956, this figure had risen at a steady rate to 176. By the end of this year, it is expected that the number will have topped the 250 mark. In Europe, exhibitions have been held or will be held this year at Cologne, Basle, Baghdad, Ghent, Innsbruck, Luxemburg, Milan, Munich, Stockholm and Vienna. This excludes the larger Brussels, Leipzig and Poznan fairs and the forthcoming International Fair of the Plastics Industry.

Until the last of the British Industry Fairs, most international exhibitions had a general flavor. All of a country's or district's wares were housed under one roof. For some time now exhibitions have been becoming specialized. Plastics, cars, boats, radio cabinets, furniture, model railways, toy, and many others have their own exhibits. Is it possible that in the future we may have to visit a steering-wheel exhibition, a tire exhibition, an engine fair, an automobile upholstery show, and a windshield wiper exposition, in order to decide what we would best like in our new car? Perish the thought!

• Gerwerkschaft Keramchemie of Siershahn/Westerwald, Germany, has appointed a British representative for the design, supply and erection of chemical and corrosion resisting plants and equipment. The new joint BTR/Keramchemie Service will provide designs and schemes for plant protection by a variety of means, such as linings of natural rubber, synthetic rubber, ebonite, PVC, polyethylene, PTFE; sprayed or brush coatings of PVC, Neoprene, Hypalon, epoxy resins; rigid PVC sheet, pipe fittings and fabrications; PTFE hose and pipes, equipment fabricated from glass resin laminates, thermosetting resins (KERA) and thermoplastic material. A joint design office will be set up in London and the services of one of Keramchemie's specialists will be available starting October 1, 1959.

• An amusing story which appears in the June issue of *The Planter* involves a Somali seaman with three wives, 16 children and no job, who was presented with a 16 pound ($6.00) income tax demand. He sent this letter to the National Union of Seamen, and it was quoted at the Union's London conference:

"On opening this epistle you will behold a deduction of 16 pounds ($6.00) as income tax from a dejobbed and much bewifed and much childrenised man. Myself did contemplate culpable homicide when proceeding home with a heart and intestines filled with misery over this 16 pound income tax.

"For Heaven's sake, Sir, consider this catastrophe as falling on your own head and remind yourself when walking home that your servant has three wives and 16 voracious children.

"Pity my horrible state as the reason given for my dejobment the incrimination was laziness. No, Sir, it were impossible that myself who has pitched 16 infant children into this world can have a lazy atom in his mortal frame."

Polyvinyl Acetate Copolymers For Adhesives

By GEORGE T. BUTTS
Supervisor, Adhesive Technical Service
Colton Chemical Company
A Division of Air Reduction Co., Inc.
Cleveland 14, Ohio

Specific adhesion to new materials now being used in packaging is obtained by altering the polymer chain

Polyvinyl acetate homopolymer emulsions have been known and widely used by adhesive manufacturers for many years. Emulsions are available which differ in such properties as viscosity, emulsifying systems and compounding behavior.

The adhesive qualities of homopolymer emulsions are sufficient for most end uses such as bonding paper, wood or cloth, but often it is necessary to compound with additional ingredients to obtain selective specific adhesion. With the increasing variety of adherents, especially in the field of packaging, better results can often be achieved by formulating from a polyvinyl acetate copolymer which contains the units needed for special adhesion permanently incorporated into the polymer chain. We believe the unique value of these copolymers make them of general interest to many sections of the industry.

Adhesive copolymer emulsions, where certain monomers are copolymerized with vinyl acetate, show enhanced adhesion to many plastic materials previously considered difficult to join. Further, the bond effected is much more stable to aging or "crystallization" than compounded homopolymers.

Prior to the copolymer entry, when a PVAc failed to adhere to a specifically resistive material, the usual idea was to find a plasticizer or solvent which would alter either the polymer's surface wetting ability or soften the substrate, providing so called "bite" at the bond surface. Difficulties were found in both instances due largely to the mobility of the added ingredients resulting in migration from the glue line and volatilization, leaving the work unsuccessfully bonded. In order to understand why these differences exist it will be helpful to first discuss the generalized structure of an emulsion.

Polyvinyl acetate emulsions are manufactured as a system beginning initially from four component groups: (1) water as the containing phase, (2) water-immiscible monomer, mostly or entirely vinyl acetate, (3) emulsifying system and (4) catalyst system. End functionality changes as any one of these factors change.

Two Points of View

A product is usually viewed in two lights: from the points of view of the supplier and the consumer. This has also been the case with adhesive emulsions. While the compounder looks for functionality and specific adhesive performance properties, his supplier interprets the emulsion in terms of physical and chemical properties and specifications.

A detailed study of all of the methods used by both sides in the evaluation work is beyond this article, but the following are the more common descriptions applicable. Classification by physical components would include solids content, ash content, comonomer ratio, emulsifier type, particle size, residual monomer, pH. Classed by usage would be adhesion, viscosity, tack (short or long) grab time, compoundability (water soluble gums, solvents both water miscible and immiscible, dry extenders, ionic materials), hardness or flexibility—including shock brittleness and blocking or heat seal temperature—water resistance, mechanical stability, freeze stability, toxicity, flammability and odor. Each of these is an extension of the four component groups.

The catalyst system which initiates and maintains the polymer formation does not concern the adhesive formulator at the time of his choosing between various emulsions, although this system is one of the primary determinants of molecular weight and is influential in producing side chains or cross-linking when desired. A formulator, however, will focus his attention on the emulsifying system and its inter-relationship to the polymerized vinyl acetate and comonomer or added plasticizer.

Basically, the emulsifying system comprises from one-half of one per cent to three or four per cent of the total emulsion and consists of two main elements: the surfactant and the protective colloid. The surfactant initially reduces the interfacial tension between monomer and water allowing an emulsion to form under agitation. A water-soluble protective colloid isolates and stabilizes the emulsion during polymerization and helps retain the finished properties for long storage periods.

This system varies with each emulsion and the ratio of either com-

ponent or quantity used runs a wide range. Some emulsions are made with several surfactants and a blend of protective colloids, while others are made with almost no protective colloid at all. As trade practice, the surfactants employed are not named *per se*, but are described only in the broad designation of non-ionic, anionic and in some cases cationic.

The protective colloid may be listed, and an emulsion may be described as "partially acetylated polyvinyl alcohol based." However, due to competitive interests, usually the functions are described and the name withheld with a description reading: cellulosic adhesive, cloudy, very stable, borax coagulated, etc.

In addition to the mentioned product stability, the emulsifying group determines many other vital factors which the adhesive compounder recognizes as tack time, machining properties and viscosity stability. Generally speaking, the colloid system determines for the formulator what the limitations will be in his choice of compounding ingredients for such prime considerations as cost reduction and machining viscosity.

Along with the polymer type, molecular weight and branching, the colloid system also influences the emulsion acceptance of plasticizers and solvents, both water miscible and immiscible. By its type and concentration, the emulsifying group in conjunction with the fusion characteristics of the emulisfied polymer, also will determine the water sensitivity of the dried film.

For example, when partially acetylated polyvinyl alcohol is used as an emulsifier, these emulsions show less moisture resistance than those stabilized with cellulose derivatives. On the other hand, a compromise must be accepted if one wishes to obtain the superior stability and bonding strength contributed by polyvinyl alcohol for paper, cloth, wood-cellulosics and related materials. Cellulose-derivative based emulsions "allow" the specific PVAc adhesive properties to show, resulting in clear, water resistant films which have increased bonding to less polar adherents.

Recently, Colton Chemical Company's technical service laboratory made a comparative study on a series of copolymer emulsions varying principally in polymer type or molecular weight. For contrast, a homopolymer was established as a control which was closely matched in emulsifier system to the copolymer series. Since the goal was to present working materials to the industry rather than finished, repackageable goods, these emulsions were designed for broadscale additions to be made in the end formulation to match end specifications.

Vinac WR-50, the comparison homopolymer, was evaluated (unmodified) in its adhesion to Mylar A, Saran's 5 and 12, flexible vinyl chloride, cellulose acetate, polystyrene and aluminum foil. As expected, when *not* compounded its performance was negative.

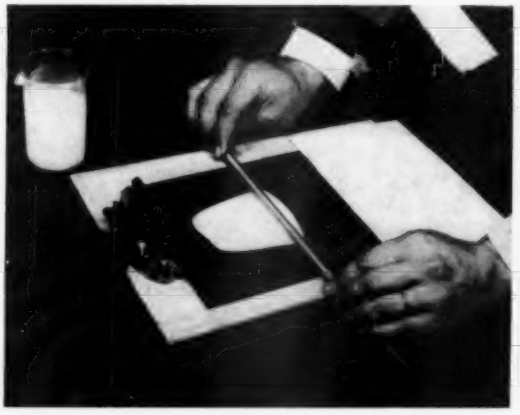
The chemical composition was altered in several different formulas

Copolymer Emulsion Table I—Solvent Compounding Viscosity at 100 Parts by Weight Emulsion: 25 Parts Solvent

Emulsion	*MEK*[3]	C_6H_6	CCl_4
Vinac WR-50	1470/2.44	3300/2.65	2000/2.63
Flexbond 126	—	770/2.59	510/2.60
Flexbond 100	—	472/2.24	228/2.14
Flexbond 128	—	920/2.50	470/2.34
Flexbond B-165	990/2.62	3250/2.96	1840/2.69
Flexbond 306	—	6900/3.22	1255/2.45
Flexbond 855	—	2950/2.88	1280/2.73
Flexbond 800	575/1.83	2450/2.24	1290/2.19
Flexbond 803	1830/1.80	o.s.[1]	o.s.[2]
Flexbond 802	1820/1.92[3]	7025/2.34	3650/2.26

Notes: Viscosity was figured @ cps ¢ 77°F. —60 rpm Brookfield/cps 12 rpm ÷ 60 rpm. [1] Off scale; over 10,000 at 60 rpm, over 50,000 at 12 rpm. [2] Off scale at 60 rpm, 35,500 cps at 12 rpm. [3] Upon mixing the emulsion at first became very thick but on further mixing, smoothed to stable mixture.

Laboratory Testing of Copolymer Emulsions



In one of the numerous laboratory tests used in research on polyvinyl acetate copolymer emulsions, an adhesive specimen is spread on a plastic laminant.

The bond is completed by covering the adhesive film immediately with a paper substrate. In the above photo, the specimen bond is tested with a 180° pull at the substrate.

Copolymer Emulsion Table II—Film Solubility from Emulsions in Poor Solvents for PVAc

Emulsion	*Heptane*	*Xylene*	*91% Isopropanol*
Vinac WR-50	Ins.	Swollen	Mushy
Flexbond 126	Ins.	Swollen	Dissolved
Flexbond 100	Swollen	Dissolved	Dissolved
Flexbond 128	Swollen	Dissolved	Dissolved
Flexbond B-165	Dissolved	Dissolved	Dissolved
Flexbond 306	Ins.	Dissolved	Dissolved
Flexbond 855	Swollen	Dissolved	Dissolved
Flexbond 800	Ins.	Dissolved	Dissolved
Flexbond 803	Ins.	Swollen	Mushy
Flexbond 802	Ins.	Dissolved	Dissolved

by compounding with a different type of plasticizer in each case. These plasticizers were chosen to represent a range of small to large (resinous) molecules and will be familiarly recognized by adhesive chemists.

Plasticizer Selected

Specifically the plasticizers were the following:

(1) Dibutyl Phthalate
(2) Benzoflex 9-88 (Tennessee) dipropylene glycol dibenzoate
(3) Santicizer M-17 (Monsanto) methyl phthalyl ethyl glycolate
(4) Nevillac 10° (Neville Chemical) phenol modified coumarone-indene resin
(5) Methox (Ohio Apex) dimethoxethyl phthalate
(6) Aroclor 1232 (Monsanto) chlorinated biphenyl
(7) Hercoflex 900 (Hercules) A high molecular weight polyester
(8) Triacetin (Eastman) glyceryl triacetate
(9) Dimethyl Formamide (DuPont)

Dibutyl phthalate is so commonly associated with PVAc resins that it has been called the "PVAc workhorse plasticizer". Triacetin, to our knowledge, is seldom used in this type of application but its chemical configuration makes it of special interest. Dimethyl formamide is listed as a solvent in most usages, but it has been shown to be so tightly tied to PVAc that solvent retention places it in the light-plasticizer category.

Similar treatment was given the copolymer PVAc emulsions with test results compared side by side. At once it was noted that uncompounded copolymer adhesion showed increased value, especially on Mylar, Saran and vinyl chloride. Each type of copolymer seemed best suited to a particular type of polymer adherent. Flexbond B-165, a vinyl acetate-vinyl stearate copolymer emulsion, performed exceptionally well on all surfaces tested.

Three types of copolymers are represented: vinyl stearate/vinyl acetate, dibutyl maleate/vinyl acetate, and acrylic/vinyl acetate. With the stearate/acetate category a study was made with emulsions of increasing copolymer concentration, while with DBM/Vac two molecular weight types were compared and, in addition, emulsions were included which varied in the emulsificant concentration and type. One acrylic/acetate polymer was selected which showed special promise.

Vinyl stearate is a wax-like monomer and at high ratios to vinyl acetate (ranging about 65 per cent upwards) the polymers produced tend also to resemble waxes. The lower ratios are considered here with the highest being 50 per cent and in these cases the vinyl stearate acts only as a permanent plasticizer.

Flexbond 126 contains 7½ per cent vinyl stearate and behaves virtually identically to the homopolymer Vinac WR-50. Its copolymeric construction appears when it is tested as a water resistant heat seal in kraft to kraft.

Flexbond 100 at 15 per cent VS and Flexbond 128 at 30 per cent VS show specific adhesion to Saran with the latter emulsion outstanding in this regard.

Flexbond B-165 at 50 per cent vinyl stearate deserves special mention in that its properties are unique for any emulsion polymer. This copolymer adhered well to all film in the test except vinyl chloride, and a small addition of DBP or Nevillac 10° made it adhere to the latter, too. A peculiarity of a film from Flexbond B-165 is its feeling of tack-freeness; however, under pressure and the slightest amount of warmth this film develops high, strong tack for almost all surfaces except perhaps polyethylene, Teflon or siliconized types.

Blend of Three

Flexbond 306 is an acrylic terpolymer; that is, it is polmerized from a blend of three monomers so selected as to provide a high degree of acrylic adhesion combined with PVAc's tensile strength and adhesiveness. Less expensive than Flexbond B-165 and almost as versatile, Flexbond 306 bonds well to Mylar, Saran, vinyl chloride and aluminum foil; however, compounding with a small amount of external plasticizer builds adhesion to Mylar and Saran but detracts from the vinyl chloride bond. In the instance of Saran or foil, the bond effected is superior and will resist water immersion over prolonged periods.

Study of DBM/VAc copolymers

Copolymer Emulsion Table III—Comparative Adhesion of Uncompounded Emulsion

Emulsion	*Ink**	*Mylar*	*Saran*	*Flexible PVC*	*Cellulose Acetate*	*Poly-Styrene*	*Aluminum Foil*
Vinac WR-50	0	0	0	0	0	1	0
Flexbond 126	2	0	0	0	0	0	0
Flexbond 100	2	0	0	0	0	0	0
Flexbond 128	2	0	2	1	0	0	0
Flexbond B-165	2	2	2	1	2	2	2
Flexbond 306	0	0	1	2	1	2	2
Flexbond 855	2	0	0	1	1	0	0
Flexbond 800	2	0	0	1	0	0	0
Flexbond 803	0	0	0	0	0	0	0
Flexbond 802	0	0	0	0	0	0	0

Notes: * Inked magazined coverstock. The scale given is as follows: 0 = no adhesion; 1 = moderate adhesion; 2 = good adhesion.

showed a specific adhesive preference for vinyl chloride with rejection of aluminum foil except in the lower molecular weight range, or with the addition of large amounts of plasticizer.

It is interesting to note that at this point in the study, Vinac WR-50, a homopolymer which has a chain length intermediate to the DBM/Vac copolymers, was compounded to contain the chemicals in the DBM copolymers and tested comparatively. That is to say, DBM monomeric plasticizer was added with water and balancing surfactants to equal the copolymer, except that the PVAc polymer here would merely be in solvent association to the DBM rather than chemically bonded.

In addition to the comparison of Flexbond 800 to this "built" Flexbond 800, both were further compounded with an external plasticizer (Santicizer M-17). Testing showed Flexbond 800 and Flexbond 800 Santicizer M-17 bonded excellently to vinyl chloride while the compounded homopolymer behaved very poorly as with any other plasticizer. This directly illustrates the essential alteration in chain configuration through copolymerization. Polymeric alteration yields an entirely different molecular form which, therefore, responds adhesively to surface topographies which can not be induced in a homopolymer.

Broadened Spectrum

The lower molecular weight DBM material has a broadened adhesive spectrum in contrast to the vinyl chloride specificity of the higher weight. In exchange it loses bond strength to vinyl chloride. Thus Flexbond 800 is very good to vinyl chloride (slightly compounded) and only poor to Saran, failing both aluminum foil and Mylar; but Flexbond 855 is very good on Saran, good on aluminum foil and Mylar while only fair on vinyl chloride.

Increasing the surfactant concentration from Flexbond 800 to Flexbond 802 results in very slight changes in specificity, but as expected, the viscosity is higher and correspondingly the porous-stock open time and mechanical stability are also increased. Most of these copolymers carry a minimum of emulsifying system to allow the greatest benefit in specific adhesion and water resistance.

Difficulties, then, sometimes arise in the mechanical handling where

Copolymer Emulsion Table IVa—Comparative Adhesion with Added Plasticizer Dibutyl Phthalate at 10 Parts per Hundred Resin

Emulsion	*Mylar*	*Saran*	*Flexible PVC*	*Aluminum Foil*
Vinac WR-50	0	0	0	0
Flexbond 128	0	2	2	0
Flexbond B-165	2	2	2	1
Flexbond 306	1	2	0	2
Flexbond 855	1	1	1	0
Flexbond 800	0	1	2	0
Flexbond 803	0	1	2	1
Flexbond 802	0	0	2	0

Copolymer Emulsion Table IVb—Comparative Adhesion with Added Plasticizer Nevillac 10° at 10 Parts per Hundred Resin

Emulsion	*Mylar*	*Saran*	*Flexible PVC*	*Aluminum Foil*
Vinac WR-50	0	0	0	0
Flexbond 128	0	2	1	0
Flexbond B-165	2	2	2	2
Flexbond 306	0	2	0	2
Flexbond 855	2	2	1	1
Flexbond 800	0	0	2	0
Flexbond 803	0	0	1	0
Flexbond 802	0	0	2	0

Copolymer Emulsion Table IVc—Comparative Adhesion with Added Plasticizer Santicizer M-17 at 10 Parts per Hundred Resin

Emulsion	*Mylar*	*Saran*	*Flexible PVC*	*Aluminum Foil*
Vinac WR-50	0	0	0	0
Flexbond 128	0	2	1	0
Flexbond B-165	2	2	2	1
Flexbond 306	0	2	0	2
Flexbond 855	0	2	2	2
Flexbond 800	0	1	2	0
Flexbond 803	0	1	2	0
Flexbond 802	0	0	2	0

Copolymer Emulsion Table IVd—Comparative Adhesion with Added Plasticizer Aroclor 1232 at 10 Parts per Hundred Resin

Emulsion	*Mylar*	*Saran*	*Flexible PVC*	*Aluminum Foil*
Vinac WR-50	0	0	0	0
Flexbond 128	0	2	1	0
Flexbond B-165	2	2	1	2
Flexbond 306	0	2	0	2
Flexbond 855	0	0	0	1
Flexbond 800	0	0	2	0
Flexbond 803	0	0	1	0
Flexbond 802	0	0	1	0

Note: The scale used is as follows: 0 = no adhesion; 1 = moderate adhesion; 2 = good adhesion.

About the Author . . .

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excessive agitation can produce coagulation, or in compounding where solvent plasticizers or even dry powders produce the same harmful effects. Increased protective emulsifier may therefore, be added by the raw material supplier or by the adhesive formulator. If it is added in the polymerization step, however, then the adaptability is reduced for the occasion where less protection is desired.

Consideration must also be given to the speed of break on porous paper where low protection adhesives break so swiftly that there is insufficient time for the emulsion particles to properly coalesce. This is similar to the water being blotted out of wet sand by tissue paper. The effect is countered by adding a water-holding, protective colloid chosen from such resins as polyvinyl alcohol, hydroxyethyl cellulose, CMC, methyl cellulose, natural water gums, etc., depending upon the supplier's compatability recommendation for the PVAc emulsion in question.

Use of polyvinyl alcohol as the emulsifying colloid in Flexbond 803 produces a very stable emulsion carrying the DBM adhesion specificity—although somewhat reduced—which also shows the cellulosic adhesion of PVA. Permanency of flexibility and copolymer water resistance is maintained, but where borax stability is required, Flexbond 803 should not be used.

Adhesion to a substrate is merely the first pre-requisite to acceptability. Finishing the product requires detailed knowledge of the application requirements, and at this point our generalized study ends, giving the formulator a series of basic emulsion resins to choose from for his building to final specifications. Copolymers are a valuable tool, augmenting the standard variety of homopolymers available supplying permanent, flexible, water-resistant bonds and extending the range of acetate emulsions into the field of packaging and film lamination.

Clamps *Can* Be Improvised

Strips of tire inner tubes—such as are often used by youngsters in slingshots—have solved a number of complicated adhesive assembly problems for Modeline Co., a Los Angeles lighting fixture company.

Specializing in the production of modernistic lamp bases, the company has been able to meet competition from makers of ceramic, plastic and metal units, by developing the design skills and assembly techniques which enable it to capitalize on the warmth of wood as a material for home and commercial furniture. The principal raw material used by Modeline is korina, a hardwood imported from the Belgian Congo. This particular wood is preferred because it has enough mechanical strength to make fragile-looking lamp components durable, and a grain structure that permits the application of six different decorative coatings.

No Nails or Screws

Assembly work in the Modeline plant is relatively difficult because of unusual and constantly changing designs as well as high standards which eliminated the use of components such as nails and screws. In its effort to solve production problems, the company has experimented with most known adhesives and gluing techniques.

For example, it had to abandon efforts to use polymerizable bonding agents because there was no practical way to heat the complicated joints used in lamp bases. Dielectric heating was, of course, a possibility, but would have necessitated a large investment in special equipment.

Similarly, many cold-setting adhesives failed to meet requirements because their use depended on pressure application with nails, clamps or presses either too costly or capable of marring the wood surface. However, the company is presently getting excellent results with a cold-setting glue, thanks to the aforementioned rubber bands.

Strips of tubing are simply stretched and either wrapped or tied around the glued assemblies. Besides maintaining the alignment of the parts, the rubber "clamps" apply just enough pressure to produce strong joints in a two to three hour cure—depending upon the weather. In addition, regardless of how tautly they are stretched, the bands never mar the hardwood surfaces.

Strips of inner tube are stretched and wrapped about the glued lamp assembly so that the components cure in correct alignment.

An Investigation into the Nature of Tack

By CARL A. DAHLQUIST
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Because tack and the methods of testing it are interdependent, technicians find that no simple definition is possible

In attempting to draft a definition which will find universal acceptance, the D-14 Committee on Adhesives of the American Society for Testing Materials describes "tack" as the ability of a material to adhere instantaneously to a solid surface when brought into contact under very light pressure. The adhesion must be such that a sensible force is required to effect separation.

Perhaps this is as good a definition as any for this interesting property, since any definition of tack is likely to be very qualitative. A more rigorous definition would require much more precise identification of the test conditions. For example, "light pressure" has rather vague significance. Light pressure on a macroscopic scale can induce high pressure on a microscopic scale, as has been so well illustrated in fundamental adhesion studies by Bowden and co-workers in England and Anderson at Bell Laboratories.

Some testing techniques which superficially appear to apply light pressures may, in reality, apply high pressures. For example, when a flexible strip is peeled from a surface to which it is adhesively bonded, a zone of compression advances before the separation zone. No matter how lightly the initial contact was made the peeling operation effects substantial contact pressure before separation occurs.

Adhering "instantaneously" is indefinite. In the time honored thumb test for tack, the dwell time is perhaps of the order of a second, and it seems quite reasonable to design tack tests around dwell times of this order of magnitude. But this is completely arbitrary, and tack ratings at one second and at one millisecond may not correlate at all.

One may ask, "What is the nature of separation? What about materials which fail cohesively? Do not all tacky materials fail cohesively?"

A concept of tack which required only adhesive failure would be far too restrictive. The pressure sensitive tape industry has recognized this and has carefully avoided the word "tack" to describe pressure sensitivity. Where the inkman's tack test involves cohesive failure, the tapeman's test (visually, at least) produces adhesive failure.

The tiremaker's tack, since it measures the ability of a rubber compound to adhere to itself, will not be considered here. The ASTM D-14 committee has proposed that this kind of tack be designated as "blocking."

Testing for Tack

A peculiarity of tack is the interdependence of the property and the method of testing it This is not true to the same degree of elasticity and viscosity. Elasticity can be measured in shear, tension, or compression, by complex deformation modes such as torsion or bending, by various stress or strain mechanisms such as constant stress, constant strain, or constant rate of strain; any of these methods, if properly analyzed, will yield a modulus which uniquely describes the material at a given time and temperature. There are some qualifications, of course. The material must be isotropic and amorphous, and it must exhibit linear behavior for moderate strains, but these qualifications will apply to most tacky materials.

Viscosity, too, can be measured by a variety of techniques to yield a reproducible constant at a given shear rate and temperature.

Measurement of tack, however, at once implies a mode of test procedure. Usually one compresses the material between two more or less parallel surfaces, then separates these surfaces at constant rate or under constant load and observes the force or time required to cause separation. The "thumb" test, or "finger tap" test, though crude and completely qualitative, is such a test.

Most of the mechanical devices which have been developed for measuring tack are essentially refinements of the finger tap test. The tacky material is in the form of a sheet, block, or coating. The test surface may be a probe or "finger" with a smooth, flat face. This finger is brought into contact with the tacky material and allowed to dwell for a specified time under specified load. It may be drawn away at specified rate and the maximum load observed, or it may be withdrawn under constant load and time for separation measured. A number of variables must be arbitrarily controlled according to the best judgment of the investigator. Some of them are:

(1) Dwell time.

(2) Load during dwell period or extent of penetration of the probe.

(3) Contact area (could be affected by penetration).

(4) Rate of separation.

(5) Temperature.

(6) Nature of probe surface (material in probe).

(7) Thickness of tacky material.

(8) Surface smoothness and general condition of the probe and adhesive surface.

In the adhesive tape industry the peel test is often used. In principle the peel test is not greatly different from the finger tap test, but, as mentioned above, the mechanics of peel introduces some variations in the dwell time history, in the geometry of the test specimen during separation, and in the rate of separation.

Green and his co-workers recognized that his tack meter, applied to printing inks, was essentially a viscometer. Subsequently a modified version of his tack meter has been introduced as an industrial viscometer.

The force-time-displacement behavior of parallel plates joined together by a viscous liquid has been investigated extensively. The time honored Stefan (*1*) equation is

$$F = \frac{3\pi\eta R^4}{2H^3}\frac{dH}{dt}$$

where F is the separating force, R is the plate radius, H is the distance between the plates, η is the viscosity and t is the time.

Integrated, the equation takes the form

$$-\frac{1}{H^2} = \frac{4Ft}{3\pi\eta R^4} + C$$

where C is a constant of integration. Stefan's equations apply when the viscous liquid fills the space between the plates at all times.

Definition Extended

Dienes and Klemm (*2*) extended Stefan's derivation to the case where the viscous material does not completely fill the space between the plates. Making the simplifying assumption that the liquid has a cylindrical form (they considered only the case where the plates approach each other) they find:

$$F = -\frac{3\eta V^2}{2\pi H^3}\frac{dH}{dt}$$

and, after integration:

$$\frac{1}{H^4} = \frac{8\pi F}{3\eta V^2}t + C$$

The fluid is considered to be incompressible so that the volume, V, is constant.

Green's (*3*) experimental work on printing inks indicates that the Stefan equation holds for plate separation if H is modified by addition of a small constant factor. He attributes this to the difficulty of keeping the plate and the fingertip in line and optically flat, so that the initial H is always a little larger than the micrometer setting. The correction factor is determined experimentally.

The most interesting outcome of this analysis is the linear dependence of force, or time, on the first power of the viscosity:

$$F_{(V, H, dh/dt)} = k_1\eta$$

$$t_{(F, V, H)} = k_2\eta + C$$

The advancing free surface of a Newtonian fluid pressed outward between parallel plates has a parabolic contour. Similarly, a Newtonian fluid pulled inwardly between parallel plates would also have a parabolic surface contour. Since this contour is independent of the viscosity, one would expect that *cohesive failure would always occur at a specific plate separation provided the fluid flow is parallel to the plate surface.*

The magnitude of the plate separation at the breaking point would depend upon the volume of liquid and initial plate spacing. If the fluid breaks up by cavitation and each segment has a parabolic shape, the same would still hold true.

It is expected that deviation from parallel flow will become serious when plate separation has effected near failure in the fluid. Deviation from parabolic flow is also anticipated if the viscosity of the fluid varies with rate of shear. This may account for differences in "stickiness" of liquids having the same viscosity reported by the Russian coworkers Margolina and Voyutskii (*4*). Stickiness was defined by Green (*3*) as the contangent of the plot of F vs. 1/t.

The effect of deviation from Newtonian flow is more easily demonstrated in the shearing of fluids between parallel plates as illustrated in Figure 1. The relationship between time for complete separation and viscosity is readily found by integrating the expression which defines the viscosity

$$\eta = \frac{F/wH}{\sigma\, dH/dt}$$

where F is the load; W is the width; H is the length of overlap; σ is the thickness of the fluid layer and t is time.

For the dead load case this leads to

$$t_o = \frac{H_o^2 W\eta}{2F\sigma}$$

where t_o is the time to failure when the initial overlap is H_o.

If the viscosity varies with the rate of shear in a manner which is not readily expressed analytically, but which is well defined experimentally, one can select values of the shear rate, dH/σdt, and the corresponding viscosity, and, by substitution into Equation 1, calculate the corresponding H. From a plot of H vs. dt/dH one can then evaluate t_o by graphical integration.

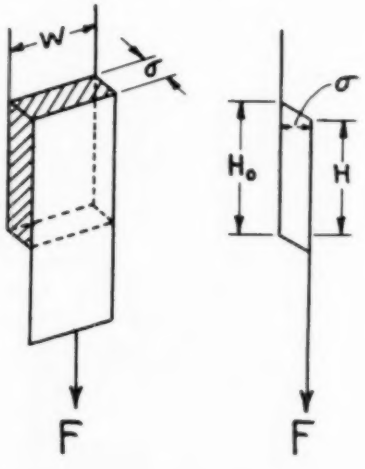
Decalin Solutions

Markovitz, *et. al.*, (*5*) have published viscosity vs. rate of shear for decalin solutions of polyisobutylene. The viscosity of a 13 per cent solution of Vistanex B-100 can be fitted very well between shear rates of 10^{-2} to 10^2 sec.$^{-1}$ by the following emperical equation in which X is log rate of shear in sec.-1 and η is in poises.

$$\log\eta = 3.35 - 0.45X - 0.12X^2$$

Calculation of time to failure for 1.27 cm. X 1.27 cm. overlap shear specimens with a 0.003 cm. thick

Figure 1—Fluid Shear Between Parallel Plates



Note: $\eta = \frac{F/WH}{\frac{dH}{\sigma\ dt}}$ = Viscosity

Table I—Overlapped Plates Pulled Apart at a Constant Rate of Shear

Shear Rate sec.$^{-1}$	*Time to failure for 1.27 cm. overlap*	*Maximum force, grams when $\eta = f(dH/\sigma dt)$*	*Maximum force, grams, when η = constant(5900 poises)*
0.423	1000 sec.	2.2	4.10
4.23	100	7.3	41.0
42.3	10	13.9	410.

Note: The initial transient state is ignored.

adhesive layer gives the following results:

Load grams	*Time to failure seconds $\eta = f(dH/\sigma dt)$*	*η is constant at 5900 poises*
1	1140	2050
2	436	1025
10	8	205

If one pulls the overlapped plates apart at constant rate of shear, the resisting force will be at a maximum at the beginning of the test and drop off linearly with time (or length of overlap) until the plates separate. The load at any given time will be determined by the shear rate, the viscosity corresponding to the shear rate, and the area of contact. Details of the preceding system at selected shear rates are given in Table I.

The marked increase in rate of flow which can result from nonlinear viscosity behavior is obvious. This is suggested as a possible explanation for Margolina's and Voyutskii's failure to correlate tack and viscosity of solutions of different kinds of rubber.

As more and more "structure" is built into the tacky material, i.e., as the tacky material becomes less fluid and more rubbery, the tack behavior becomes much more complex.

First, a change in flow behavior is observed. The adhesive cannot be drawn in to fail at the center but breaks up into teeth or legs. Secondly, there is a progression toward failure at one adherend-adhesive interface. This usually occurs at the plate surface which last contacted the adhesive, provided other conditions, such as construction material, contact area, and cleanliness, are the same for both plates. The cleanliness of the break may be superficial—but regardless of whether the failure is in adhesion or cohesion, the failure zone moves very near to one interface.

As the deformation becomes more elastic and less viscous, the time dependence of flow will be governed by the time dependence of elastic processes rather than the shear rate dependence of the viscosity. A more complex stress-strain behavior is encountered. At constant rate of plate separation the maximum resisting force is not reached at once but increases with extension. Under constant load there is initial rapid extension followed by creep. A complete analysis involving the geometry of flow, the geometry of adhesive breakup, and the geometry of adhesive failure becomes exceedingly complex.

Let us consider a single strand of adhesive extended at constant rate. We will assume the strand fails cohesively through flow, *i.e.*, it does not have sufficient structure to reach an ultimate extension and fail abruptly, but it will exhibit recoverable elasticity when stretched and released.

The modulus in extension is

$$E = \frac{\text{Stress}}{\text{Strain}} = \frac{M/A}{(L-Lo)/Lo}$$

where M is the load, A is the Area with

$$A = \frac{AoLo}{L} \quad \text{(at constant volume)}$$

L is the stretched length, Lo is the original length and L-Lo is the extension.

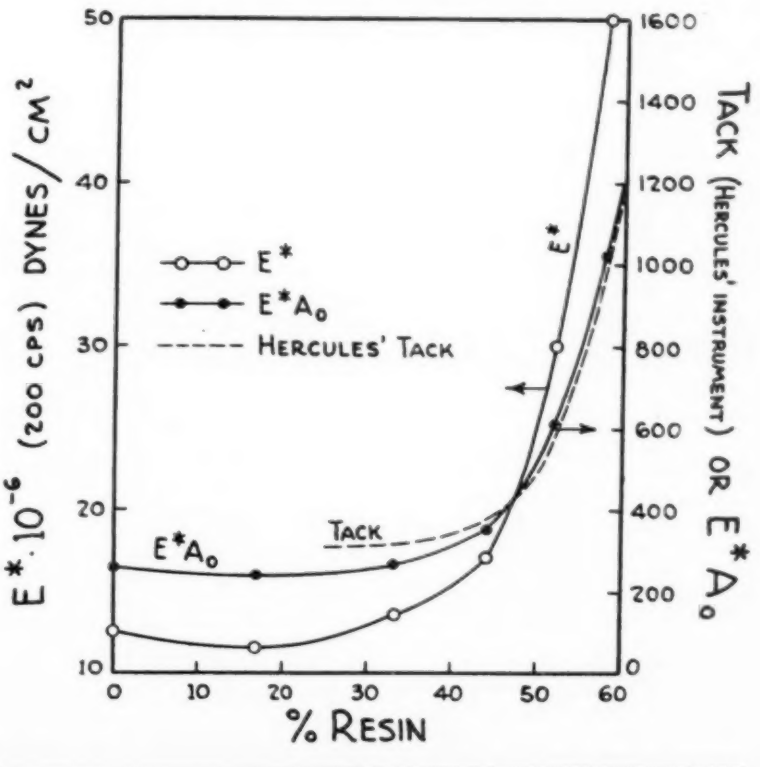
Rearranging and replacing A by

$$\frac{AoLo}{L}$$

we have

$$M = E\,Ao\left(\frac{L-Lo}{L}\right)$$

Figure 2—Extension of Soft Viscoelastic Material



Note that as L becomes very large,

$$\frac{L-Lo}{L}$$

approaches 1, and M approaches EAo as a limiting value.

Figure 2 shows a plot of

$$\frac{\text{Load}}{EAo} \text{ vs. } \frac{L}{Lo}.$$

The Load vs. Strain curve is typical of the behavior one observes when strips of soft viscoelastic material are pulled in a tensile testing machine. According to this highly over-simplified picture the maximum load would be determined by the elastic modulus of the adhesive.

Wetzel (*6*) and co-workers have published tack measurements for a series of natural rubber; rosin tackifier blends:

Composition % *Rubber*	% *Resin*	*Av. Tack, g.per 1/16" diameter probe*
75	25	290
67	33	300
60	40	450
50	50	935
40	60	1250
33	67	615
25	75	0

The tack instrument used in the above experiment consisted of a flat ended probe which was allowed to dwell on the adhesive under constant load, then was separated from the adhesive at constant rate. The time required to effect separation of the probe and the adhesive surface was estimated to be 0.01 second.

In this time range the complex tensional modulus of natural rubber, E*, is approximately 10 X 10^6 dynes per cm^2. Incorporation of the resin would tend to increase E* so that it might reasonably vary from 10 X 10^6 to 50 X 10^6 in the first five compounds of the series. If we calculate the maximum load, EAo, (for this instrument Ao = 0.02 cm^2) we have

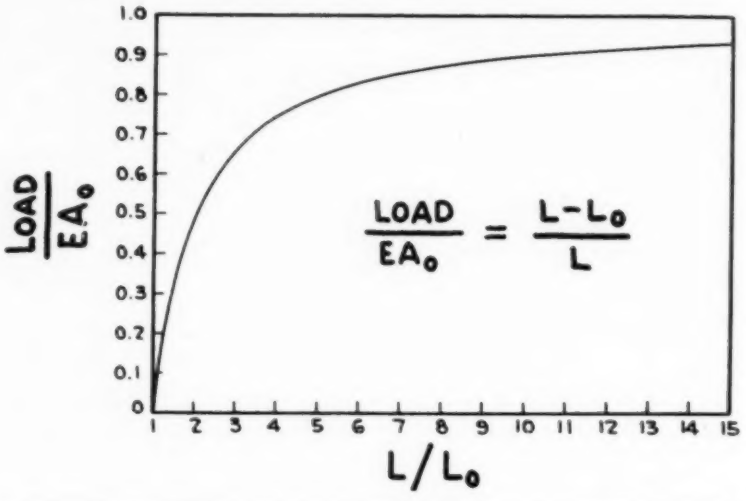
$$\text{Load}_{(E^*=10\cdot10^6)} = \frac{10\cdot10^6\cdot0.02}{981} = 204 \text{ g.}$$

$$\text{Load}_{(E^*=50\cdot10^6)} = 1020 \text{ g.}$$

Perhaps the agreement with the experimental data is fortuitous, but further investigation seems warranted.

Unfortunately, tensional modulus data on the above natural rubber-tackifying resin blends were not available, but some dynamic modulus data had been obtained on a very similar rubber-rosin derivative system. The variation of E* with resin content and the corresponding E* Ao values are shown in Figure 3 along with Dr. Wetzel's data. The similarity of the shape of these curves and that of Dr. Wetzel's tack data is very striking. Note also the excellent agreement between the E*Ao values and the "tack" values.

Figure 3—Modulus and Tack of Visoelastic Materials



D. H. Kaelble obtained tack measurements using a similar instrument operating under constant load and measuring time to failure. Some of these data were published by M. R. Hatfield and G. B. Rathmann. (*7*) Experimental details were:

Probe—Polymethyl methacrylate
Adhesive—Polyisobutylene
Probe Area—0.1 cm^2
Load—variable

Constant Load Analysis

One can analyze the constant load experiment in the same manner that we treated the constant rate experiment, again assuming that tensional modulus is the controlling factor. In the equation below,

$$A = \frac{AoLo}{L}$$

$$\text{Elongation} = \frac{L-Lo}{Lo} = \frac{\text{stress}}{\text{modulus}} = \frac{M/A}{E}$$

For the polyisobutylene used by Kaelble the tensional modulus in the time range of 1 second to 100 seconds is approximated quite well by the emperial expression:

$$E = 7.0 - 1.25 \log t$$

where t is in seconds and E is in megadynes/cm^2.

It was first assumed that failure might occur at some particular extension, *i.e.*, at some value of

$$\frac{L-Lo}{Lo}.$$

The corresponding times were calculated for the loads used in the experiment.

However, the calculated values showed no correlation with experiment and it was obvious that the assumption of a constant

$$\frac{L-Lo}{Lo}$$

at failure was incorrect.

It was then assumed that the extension at failure was proportional to the load, such that

$$\frac{L-Lo}{Lo} = k\,M.$$

$$\text{Letting } \frac{L-Lo}{Lo} = a$$

$$\text{then } \frac{L-Lo}{L} = \frac{a}{a+1}$$

Substituting in

$$\frac{L-Lo}{L} = \frac{M}{AoE}$$

we have

$$E = \frac{M}{aAo}(a+1)$$

If extension at failure is proportional to the load, M/a is a constant.

About the Author . . .

CARL A. DAHLQUIST joined Minnesota Mining and Mfg. Co. in 1943 as a research chemist in the firm's Central Research facility. His background included a degree in chemical engineering from the University of Minnesota, and graduate work in physical chemistry, chemical engineering and bacteriology. In 1953, he became a research associate at 3M and in 1957 was appointed to his present job, supervisor of basic research for the Tape Research Department.

In fitting this expression to Kaelble's data, the appropriate value of "a" for the smallest load was selected, and again using the emperical expression, $E = 7.0\text{-}1.25 \log t$, the time to failure was calculated with the following results:

M	*a*	*Calculated Time*	*Observed Time*
100g	0.28	103	103
150	0.42	42	41
200	0.56	17	16
250	0.70	7	9
300	0.84	2.8	5

The agreement between observed time and calculated time is very satisfactory, supporting the assumption that tack of polyisobutylene, as measured by this technique, is a modulus controlled process. However, the proposal that the extension at failure is proportional to the load has not been justified on a theoretical basis nor confirmed experimentally.

Theory Incomplete

The above theory is attractive and certainly has some merit, but it is incomplete. Some have referred to it as a "fuse theory" because it postulates sudden adhesive or cohesive failure, the load-strain-time behavior up to the failure point being controlled by the viscoelastic properties of the adhesive. Two very important considerations, however, are left unexplained:

(1) Tack values vary depending upon the nature of the test surface.

(2) Tack does not increase indefinitely with modulus or viscosity, but goes through a maximum value and diminishes.

If it were true that tacky materials always fail cohesively, as some have postulated, then it would seem that tack would be the same for all test surfaces as long as cohesive failure does not take place within the test surface. Such failure can occur, particularly if the surface is covered with a liquid film, and this can lead to a possible erroneous evaluation of tack.

For example, if one applies the finger test to an oil resistant pressure sensitive adhesive, one is apt to conclude the adhesive has no tack. However, if the natural body oils are first removed from the finger, the tack will appear as good as that of any other pressure sensitive adhesive presently available.

But there are many materials which, as test surfaces, yield much lower tack values than glass or steel or polymethyl methacrylate, yet are so much higher in cohesive strength than the tacky adhesive that it is impossible to rationalize this behavior in terms of cohesive failure of the adherend. Good examples are both polyethylene and polytetrafluoroethylene.

Defining Upper Limits

That tack does not increase indefinitely with modulus or viscosity may be due primarily to the difficulty of bringing materials into sufficiently intimate contact for bonding. It is difficult to define the upper limits of viscosity or modulus where tack begins to disappear. Since these properties are time dependent, the dwell time becomes important, and the tack value may vary greatly depending on contact time—1 sec., 0.1 sec., 0.01 sec. The use of heat or solvents to increase tack is common practice, and this has the effect of reducing the modulus or viscosity.

Best tack is achieved where adhesives have a low modulus in the time range selected for bonding and a high modulus in the time range selected for separation. Rosin in rubber has this effect if bonding time is moderately long, say one second, and separation time is short, say 0.01 second. Generally speaking, an oil-plasticizer is not as effective a tackifier because it does not produce the high modulus at short separation times.

A very attractive rate theory of adhesion, which does not involve the viscoelastic properties of the adhesive except as they affect the free energy of activation of an adhesive bond, has been proposed by Hatfield and Rathmann (7). While their absolute rate theory has not been evaluated for general use in integrated form, they have examined its main implications, which are:

(1) A critical load value, below which the adhesive bond will never fail, can be calculated.

(2) The work of adhesion has a profound effect on time to breakage for a given load, although it represents a small fraction of the energy expended.

(3) The free energy of activation for viscous flow also has a marked effect.

Necessary Compromise

In conclusion, it seems that any reasonably complete theory of tack must be a compromise, or merger, of the fuse theory and the absolute rate theory. It must take into account the relaxation processes or diffusion phenomena involved in bond formation, particularly if the time allowed for bond formation is in the time scale of the fastest relaxation processes of the adhesive. It must consider the flow of the adhesive, which, whether viscous or elastic, seems to be the principle rate controlling process under most circumstances. Finally, it must include an adhesive force, or work of adhesion, which can play a dominating role when it becomes small relative to cohesive strength.

Literature References

(1) Stefan, Sitzber Akad. Wiss. Wien Mathnaturw, *Klasse Abt II*, 69, 713 (1874).

(2) G. J. Dienes and H. F. Klemm, *J. Appl. Phys.*, Vol. 17 458 (1946).

(3) H. S. Green, "Industrial Rheology and Rheological Structures," Wiley, (1949).

(4) Y. L. Margolina and S. S. Voyutskii, Zarodskaya Lab Vol. 14 321 (1948); *Chem. Abstr.*, 44 (5g).

(5) H. Markovitz, L. J. Elyash, F. J. Padden, Jr., T. W. DeWitt, *J. Coll. Sci.*, Vol 10 165 (1955).

(6) F. H. Wetzel ASTM *Bull.*, No. 221, 64 (1957).

(7) M. R. Hatfield and G. B. Rathmann, *J. Phys. Chem.* Vol. 60 1957 (1956).

Painting tool manufacturer speeds

Mohair-Plastic-Metal Bonding

In an attempt to solve painting problems encountered by professional and "do-it-yourself" painters, inventor Paul V. Imhof designed two unique pieces of equipment, both of which were admirably suited to the job. The design of both units involved an adhesive problem, however, in that both units comprised a metal handle overlaying a polyester foam pad to which was laminated a fine quality cut of mohair.

Mr. Imhof, head of the Immie Corporation of Rochester, N.Y., was now faced with this production problem: how to bond mohair to the polyester foam, and how to bond the polyester foam, in turn, to the metal handle.

One of the units designed by Mr. Imhof was a sash painter which is said to eliminate one of painting's most exasperating chores. The other unit, an edge painter, is designed for the straight-line edging of walls, ceilings, baseboards, floor and trim.

In operation, the polyester plastic pad compresses against a metal guard edge, eliminating the danger of paint smear on any adjoining surface.

Supplier Called In

In setting up production, obtaining a suitable adhesive was his biggest headache, the inventor recalls. "I can't begin to remember how many we tried, how many we experimented with." The problem was eventually turned over to technicians at Rubber and Asbestos Corp., Bloomfield, New Jersey, and the latter developed a formulation which "measured up on all counts, and manufacturing proceeded in full gear."

In fact, it was the adhesive which brought the Immie units to their present shape and form. Earlier they were made with wooden handles and the mohair-covered polyester foam was stapled to the wood. However, this did not produce the eye appeal nor the workability which could be achieved with a light gauge metal.

Bondmaster G379, the adhesive developed for the Immie application, handled two production line laminating problems. It bonded the mohair to the polyester foam, and the plastic pad itself to a metal frame. As Immie personnel report, "It did the job faster, easier and at less cost."

One of the most important characteristics necessary in an adhesive for this kind of end-use is superior resistance to all tpyes of paint thinners and brush cleaners, as well as water. Immie production engineers subjected G379 to a series of rigorous tests to determine its effectiveness. They discovered that even after being immersed in various solvents for an extended period of time, the adhesive proved stronger than either of the materials it had joined together. In pushing tests to the point of destroying the specimen, it was found that the polyester foam pad would often rip apart, but its bond to the mohair remained intact.

The first step in the manufacture of the Immie painting aids involves the bonding of large sheets of mohair to polyester foam. A damp sheet of finest quality mohair is placed face down on the lamination table where hinged flange boards hold it firmly in place. The adhesive is then poured into a metal receptacle at one end of the table and metal spreaders are used to apply a thin, uniform coating over the underside of the mohair.

Excess adhesive is returned to the metal tray. Important in this phase of production is the fact that the adhesive dries slowly enough to allow ample time for even spreading before the large pad of polyester foam is joined to the coated mohair.

The foam pad is laid on the wet adhesive and the operators smooth it out with their hands. This provides enough pressure to produce a bond strong enough to hold the two materials together until the pad is placed in a press for 15 minutes to complete the bonding operation.

The tenacious over-all bond formed in this way not only cuts potential product rejection, but allows the large sheets to be cut cleanly into small pads with ravel-free edges.

The assembly operation begins when pre-formed metal handles are upended in wooden racks and a uniform strip of adhesive is applied to the undersides with the aid of a squeeze bottle. The bonding properties of the adhesive formulation make it possible to achieve strong, durable bond without coating the entire undersurface of the handles. This not only makes for appreciable savings in material, but cuts labor and production time costs.

Mass Application

The slow drying time of the adhesive is important in the assembly operation too, as it permits the application of adhesive to several hundred handles at a time before the pads are mated to the metal. Should the adhesive accidentally be allowed to harden partially, it can be reactivated by simply applying a solvent-dampened cloth.

Assembled Immie units are routed to the shipping room where they are labeled and packed into cardboard cases.

Bondmaster G379 is a synthetic rubber-resin based adhesive using an MEK solvent. A new development in the field of oil and aromatic fuel resistant adhesives, earlier formulations have been used successfully in such bonding applications as nitrile rubber to steel, wood veneer to rubber-impregnated paper, aluminum foil to vinyl film, and glass to aluminum. It is bonded by solvent reactivating the dry adhesive with MEK, or by heat reactivating the dry adhesive at 250°-350°F.

1—Adhesive from the metal tray at the far end of the table is coated over the back of the mohair with metal spreaders.

2—The polyester foam pad is placed over the adhesive-coated surface and light hand pressure applied to form a bond.

3—Wet adhesive "legs" indicate the strong, over-all bond which forms between the mohair and the plastic.

4—Closeup view of destructive test of bonded pad after solvent soaking tests. The plastic gives, but the bond is unaffected.

5—Over-all view of portion of production line in which upended metal handles supported in racks are striped with adhesive.

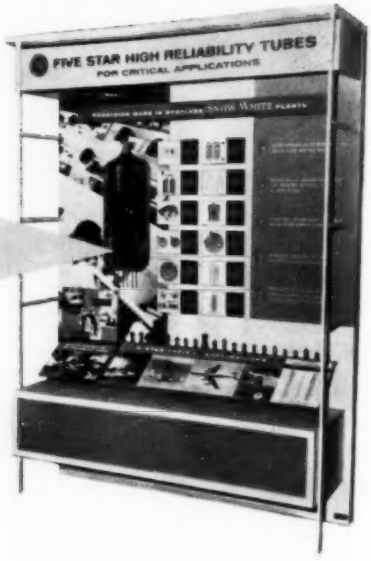
6—Camera provides a detail shot of adhesive being applied from squeeze bottles to pre-formed metal handles.

7—Notice that a firm, durable bond is obtained between the plastic and metal without coating the entire undersurface.

8—Completely assembled painting tools are labelled and packed for shipment. Consumer response has been enthusiastic.

STAFF REPORT

ADHESIVES on DISPLAY



An Investigation of Adhesives Used in Advertising Exhibits

Trade shows have become one of our most important advertising and sales promotion media. Whether the purpose is to produce direct sales or improve public relations, displays are idea demonstrators of tremendous impact that save, at a glance, many thousands of words of explanation.

A majority of displays are constructed and assembled with adhesives. Recently, ADHESIVES AGE visited Mastercraft Associates, Inc., 360 West 11th St., New York, N.Y., a leader in the field of displays and exhibits, to find out exactly to what extent adhesives are being used in displays. An interview with Sidney Wasserman, vice-president of Mastercraft, revealed some pertinent information about the part being played by adhesives in the construction and assembly of displays.

Question: What types of adhesives do you use in your display construction operations?

Answer: We use a liquid resin glue, a urea resin powder, Duco cement, Rez-n-glue, Pliobond and various contact cements. The application of each one of these adhesives is determined by the nature of the materials to be bonded.

Question: How much adhesives do you consume in a month?

Answer: We use about 50 pounds of liquid resin glue per month and about 15 pounds of urea resin powder per month. Our other bondants are used frequently, but not in large, measurable quantities.

Question: Are the adhesives ready to use or do you prepare them in your shop prior to application?

Answer: The liquid resin glue is prepared by the manufacturer and we take what we need directly from his shipping container. We prepare the urea resin powder by mixing a specific quantity with water. This is done about 20 to 30 minutes prior to actual bonding application.

Question: Does temperature and humidity have any effect on the adhesives used?

Answer: Yes, temperature and humidity are a factor in our adhesives operations. For proper gluing condition of all types of adhesives which we use, a minimum shop temperature of 55°F. is maintained during the winter months. On days which have a high humidity, a longer drying time is required for the liquid resin glue and the contact cements. During cold weather the setting time on all glues is about double that of warm weather. Humidity affects the glue mixture in such a way that it seems to disintegrate and is no longer usable after about six hours.

Question: How long have you been using adhesives in the construction and assembly of your displays?

Answer: We have been using various adhesives since the beginning of over-all shop operations. We felt that adhesives could facilitate display construction and assembly more readily than nails, staples and wires.

Question: During your construction operations, where are the adhesives handled?

Answer: The adhesives are handled by our employees at individual construction locations. In the Carpenter Shop, the adhesive being used is taken to the bench of the carpenter who is assembling wood parts. It is usually a practice in our Art Department to bring the adhesives next to the layout area where materials are to be mounted on the display.

Question: In the construction and assembly of your displays, what materials are being adhered?

Answer: In our Carpenter Shop, wood parts are assembled into finished sections. We adhere wood-to-wood, and wood-to-Formica. Textolite, or equal, is bonded to plywood. In building display forms we use adhesives, and also in the manufacture of bentwood shapes used in exhibits. In our Art Department, adhesives are used to mount photographic murals to framed panels which, in turn, are mounted in overall coverage or on painted panels on the display itself. The mounted

photographs are cut out in free shapes prior to mounting on the display. Type captions are adhered to finished display surfaces near the photographs. Cutout letters are also adhered to finished surfaces. We also use adhesives to mount customers' specimen products to the finished surfaces of the display. The specimen products are either of paper, wood, steel or plastic.

Question: Why are you using adhesives?

Answer: By using adhesives in our construction and mounting operations we reduce extra labor costs, and produce a "finished" finished display . . . not one with unsightly nails and staples.

Question: What are your methods for applying the adhesives to the materials to be bonded?

Answer: The liquid resin glue is taken from the manufacturer's shipping container in a small dixie cup and applied manually with a brush. The shop-mixed urea resin glue is also applied with a brush over a small area, and with a paint roller on large areas, which gives us an even application. The Duco cement and Rez-n-glue is applied directly from the tube nozzle. Pliobond and plexiglas cement is applied with a small touch-up brush. On occasion we also apply the plexiglas cement with a hypodermic syringe. The contact bond which we use for adhering phenolic plastic laminates is applied with a paint roller and evened off with a metal sawtooth spreader. A squeegee is used to apply linoleum paste.

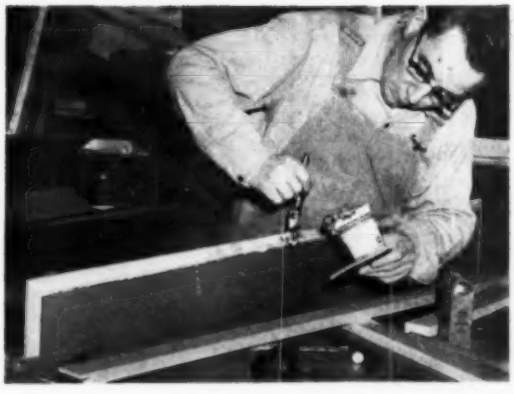
Question: What is your precedure after the adhesives are applied and the materials joined together?

Answer: Materials bonded with the liquid resin glue are clamped with hand screw clamps, and after 1½ hours the glue has set enough to permit light machining. It is totally dry in 6 to 8 hours and ready for complete machining. Materials bonded with the urea resin glue are boiled dry with a dielectric machine. We run the machine over the bonded parts and the glue sets in a matter of seconds. When it is necessary to bond materials with Weldwood glue, the materials are clamped with hand screw clamps until the glue has set. This takes between 12 and 14 hours.

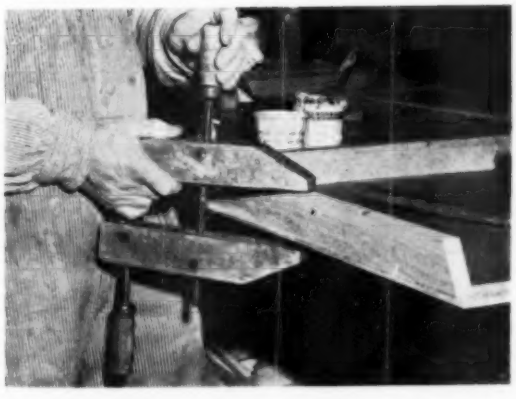
Question: What is the life expectancy of the adhered joints on your displays?

Answer: Under normal wear and tear, and without being water-soaked, the life expectancy of the glued joints is for a long period of time, usually

Carpenter pours liquid resin glue into container for application at work bench.



Using a brush to apply glue to a display side panel. Rollers are used on larger pieces.



Using a hand screw clamp to hold bonded wooden frame during initial cure period.

A dielectric machine is used to set materials banded with urea resin glue.

Applying glue to a display disc which will then be adhered to the finished panel.

A photograph being mounted on a plaque. Photos are water-soaked to make them flexible.

Paint spraying a panel which is covered by frisket lettering. Rubber cement is used here.

After paint has dried, frisket, which is adhered by rubber cement, is peeled off.

far outlasting the usefulness of the display itself. We have found that joints bonded with the urea resin glue and set with the dielectric machine are most durable.

Question: What is the pot life of the adhesives you use?

Answer: The liquid resin glue is applied from dixie cups, metal cans and rubber bulb syringes. Pot life in the syringe is from six months to a year; from two weeks to a month in the cups and cans. The urea resin powder glue is mixed with water in a metal container with enough being prepared for individual application. The remaining mixed glue is discarded and the container washed out and re-used.

Question: What are the advantages of using adhesives?

Answer: With the combination of the urea resin glue and the dielectric glue machine, a speed-up of production has been achieved. The bonded material is immediately ready for further phases of production such as additional joining, sanding, cutting, drilling, over-all assembly, final painting and finishing.

Question: Did the use of adhesives solve any particular construction problems?

Answer: Yes, we previously wired customers' specimens to plaques for display purposes. We now almost exclusively adhere the specimens with Rez-n-glue, Pliobond, Duco cement and Contact Bond, whichever is applicable to the specimen material.

Question: Do you have any special glossary of terms in referring to the adhesives, its usage and application?

Answer: We refer to the liquid resin glue as white glue. The urea resin glue is called cold glue or Weldwood glue.

Question: Do you contemplate any future uses of adhesives?

Answer: We plan to continue to use adhesives wherever possible, and as new, improved adhesives are introduced we will use them in an effort to secure stronger bonds, thus constantly improving our finished product.

Question: Who are your adhesive suppliers?

Answer: Liquid resin glue is supplied by Pilot Chemical Co.; urea resin glue by U.S. Plywood Corp.; Rez-n-glue and Plexiglas cement by Schwarz Chemical Co.; Formica Contact Bond by Mechanics Lumber Co.; and a local hardware store for linoleum paste, Pliobond and Duco cement.

How the Adhesive Manufacturer and User can

Eliminate Solvent Hazards!

PART 1 of this article presents a general survey of the field as well as a detailed analysis of possible inhalation hazards and what can be done about them

By **SAMUEL MOSKOWITZ**
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New York Dept. of Labor

Not too many years ago, the only adhesives available for industrial use consisted of water solutions of gums, such as dextrin and gum arabic, or of animal glue. Large quantities of these aqueous solutions are still being used, but to them have been added other aqueous emulsions with or without organic solvents, and adhesives which contain a considerable percentage by volume of volatile organic solvents.

In addition, there are virtually solvent-free adhesives which set-up by polymerization, either at room or at elevated temperatures. In the latter category there may be some volatile monomer contained in the adhesive as it is applied and before it is cured. This article will confine itself to possible harmful effects of organic solvents on people, and what preventive measures can be taken.

The hazards which might arise from the use of solvents or of solvent containing materials may be grouped under three general headings: (1) inhalation hazards, (2) dermatitis hazards, and (3) fire and explosion hazards. Each of these categories will be considered separately.

Inhalation Hazards

Solvents which are used in or for adhesives are generally expected to evaporate completely and reasonably rapidly. The vapors of some solvents used have only narcotic effects when inhaled. However, there are a number which have other, more serious, physiological effects. Among these are benzol (benzene) which is an aromatic hydrocarbon and has a deleterious effect on the circulating blood and on blood forming organs. Others include carbon tetrachloride and other chlorinated hydrocarbons which may affect the liver, the kidneys or the blood. Carbon disulfide, for example, is well known for its effect on the central nervous system.

The American Conference of Governmental Industrial Hygienists (ACGIH) has a Committee on Threshold Limit Values which annually publishes a list which gives the concentrations of, among other atmospheric contaminants encountered in industrial establishments, solvent vapors which ". . . represent only conditions under which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect."

The Threshold Limits (sometimes called Maximum Allowable or Acceptable Concentrations, and abbreviated MAC) for some of the solvents used as such or in solvent-containing adhesives are:

Solvent	*MAC in Parts Per Million*
acetone	1,000
amyl acetate	200
amyl alcohol	100
benzol (benzene)	25
methyl ethyl ketone (butanone)	250
butyl acetate	200
butyl alcohol	100
butyl cellosolve	50
carbon disulfide	20
carbon tetrachloride	25
cellosolve	200
cellosolve acetate	100
chloroform	50
cyclohexane	400
cyclohexanol	100
ethylene dichloride (1, 2-dichlorothane)	100
diisobutyl ketone	50
dioxane	100
ethyl acetate	400
ethyl acrylate	25
ethyl alcohol	1,000
ethyl ether	400
hexane	500
heptane	500
methyl isobutyl ketone	100
isophorone	25
methyl acetate	200
methyl acrylate	10
methyl alcohol	200
methyl cellosolve	25
methyl cellosolve acetate	25
methyl chloroform	500
methyl cyclohexane	500
methylene chloride	500
naphtha (coal tar)	200
naphtha (petroleum)	500
methyl propyl ketone	200
perchlorethylene	200
propyl acetate	200
propyl (iso) alcohol	400
propylene dichloride	75
Stoddard solvent	500
styrene	100
1,1,2,2-tetrachloroethane	5
toluene (toluol)	200
trichlorethylene	200
xylene (xylol)	200

In the manufacture of solvent cements there are several procedures which can and should be followed in order to minimize employee exposure to solvent vapors. First, solvents with the lowest toxicities should be used in preference to those whose toxicities are higher. In each class of solvent there are choices which may be made, and which should not be based on cost alone.

The author has seen a neoprene cement made with a considerable percentage of benzol where toluene or cyclohexane could have been used with considerably less hazard to the employees of the manufacturer and of his customers. Similarly, one man-

ufacturer was found to be using methyl cellosolve. When it was pointed out to him that cellosolve has almost identical properties (the only major difference is that cellosolve evaporates more slowly), he found that he could substitute the much less toxic substance for the methyl cellosolve he had been using. The substitution of less toxic substances will be taken up in the section on the use of adhesives.

The equipment used in the manufacture of an adhesive is usually some kind of mixer. To prevent unnecessary evaporation of solvent during the mixing operation, this unit should be kept closed at all times. However, since it is impossible to add materials or remove a product from a totally enclosed container, the solution lies in making the mixer as tightly closed as possible. Any opening necessary for reasons other than the addition or removal of materials should be vented to the outdoors. In some cases an exhaust blower will be found necessary to prevent leakage of solvent vapor from the mixer.

Using Direct Piping

Liquids should be added to a mixer through piping directly connected to the mixer, so that displacement of vapor-containing air will be through the vent already provided. If solids are added prior to the addition of any solvents, although this is not the usual practice, they may be added to a mixer which is completely free of solvent and solvent vapor without causing any vapor to reach the workroom. However, if solids are added after volatile solvents have been introduced into the mixer, vapors will leave the mixer unless these are removed as rapidly as they are released.

This may be done with local exhaust ventilation in a variety of ways. Air may be mechanically exhausted from the mixer at such a rate that it will enter the loading port with a velocity sufficiently high to prevent the escape of vapors through that opening. Another method is to construct a ring-shaped slot-type hood around the loading port. If the port is small enough, a slot half way around is adequate. Sufficient ventilation should then be provided to capture solvent vapors which are displaced from the mixer as materials are added.

An alternate method would be to stand the mixer in a mechanically ventilated booth-type enclosure. This booth should resemble a paint spray booth but need not be as deep in relation to its height and width. The velocity of air into the open face should be sufficient to control possible escape of contaminants into the general air of the workroom. This type of control will also be useful during the removal of completed adhesive from the mixer.

The last and least desirable method for controlling vapors which might be released into the air during manufacturing operations is that of providing mechanical general ventilation in the workroom. In order to be able to calculate the quantity of air required to keep the concentration of solvent vapor below its MAC, one must know the rate at which the solvent is being evaporated into the air, preferably its maximum rate. These data are usually not readily available in an adhesive manufacturing plant. However, assuming that such data can be obtained the required ventilation can be calculated by using the following formula.

$$CFM = \frac{403 \times 10^6 \times \text{sp.gr.} \times \text{pts./min.} \times K}{\text{mol. wt.} \times \text{MAC}}$$

CFM is the ventilation rate in cubic feet per minute; sp. gr. is the specific gravity of the solvent; pts./min. is the quantity of solvent evaporated in pints per minute; mol. wt. is the molecular weight of the solvent; MAC is the Threshold Limit of the solvents; and K is a constant.

The constant K in the above equation is introduced to provide for uneven dilution of the solvent vapor in the workroom. The distance between the points where vapor is released and those where air is exhausted from the room, as well as the location of fresh air inlets, constitute important considerations in calculating the rate required for general ventilation. The value of K may vary from 3 to 10 but is usually 4 to 6.

Sample calculations for some of the solvents previously listed will soon indicate that general ventilation may be used when moderate quantities of the less toxic solvents are evaporated. However, this method is prohibitively expensive as well as exceedingly undesirable when more toxic solvents, such as benzol or carbon tetrachloride, are to be diluted to relatively safe concentrations. However, the use of such solvents is to be avoided except in completely closed systems.

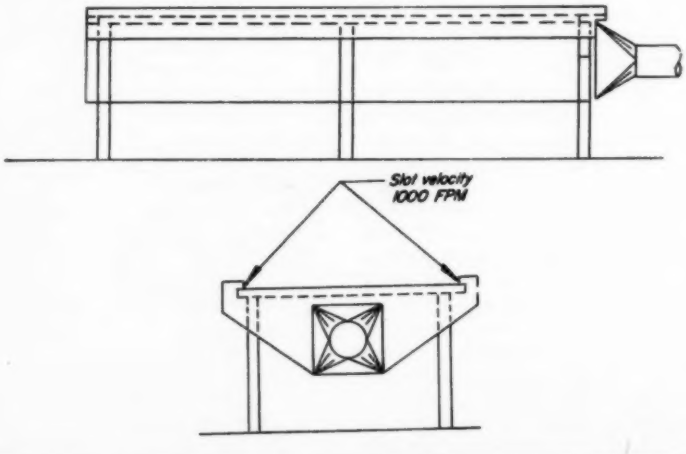
Provides Better Control

Although general ventilation may be practical when solvents of low toxicity are employed and the cost of installation may be lower, the use of local exhaust ventilation methods gives more positive and satisfactory control of the inhalation hazard.

The inhalation hazard in factories in which solvent containing adhesives are used can be much greater than in those in which such adhesives are manufactured since the solvent must be evaporated completely in use. The principles of protection are identical; only the application may vary.

The presence in cements of solvents which are the least toxic possible is something which the consumer of adhesives should insist upon. At this point it might be apropos to speak about product labeling.

Figure 1—Table Design for Spreading Wide Materials



Many states and some cities in the United States have laws which require that containers with hazardous substances be adequately labeled. A label which follows the recommendations of the Manufacturing Chemists Association in its Manual L-1 will satisfy most, but not necessarily all, governmental regulations. The Committee on Standard Labeling Procedure of the American Conference of Governmental Industrial Hygienists has written a set of rules and regulations on the labeling of hazardous substances which, it is hoped, will be adopted and enforced as a uniform set of nation-wide regulations.

One of the advantages of the ACGIH rules and regulations is that the labeling of mixtures, which is important in many industrial products, is provided for in what is believed to be a more realistic manner than in other sets of regulations or recommendations now in use.

Generally, the label on a container of a hazardous substance should be large and legible. It should have the chemical name, not merely the trade name, of all hazardous compounds which are present in significant concentrations, a signal word to indicate the degree of hazard (Danger, Warning, or Caution), statements of the principal hazards, precautionary measures to be observed, first-aid instructions, methods for the disposal of the empty container (when practical), and the name and address of the manufacturer. In addition, the word "poison" and a skull and crossbones in red should appear when substances which can cause acute or slow poisoning are present.

The International Labour Office, a United Nations agency, with headquarters in Geneva, has also prepared a set of recommended labels for hazardous substances. Its labels utilize symbols for signal words to indicate to those who are illiterate that hazardous substances are present in the container. A warning or precautionary label is useful in informing both management and labor that there are hazardous substances in the container so that both can exercise the necessary precautions and use proper controls to avoid injury. Such labels also enable management to select materials which have the lowest toxicities.

It cannot be over emphasized that it is usually unnecessary to employ any of the more toxic solvents as constituents of adhesives or as solvents to clean surfaces or make them tacky for self adhesion. It is management's responsibility to make every effort to procure adhesives or solvents which contain the most innocuous substances consistent with the use requirements. In some cases, if management does not exercise the best judgment in its selection of solvents or solvent-containing materials, labor may take a hand.

It is not unusual for our organization to receive complaints from employees or employee groups that injuries are occurring in factories. Where solvents are the causative agent, we invariably recommend the use of less toxic materials and provision for proper ventilation.

Some time ago we investigated health injuries which resulted from the use of benzol in fast drying inks in the rotogravure industry. The injuries were real in spite of the use of local exhaust ventilation on the printing presses. Medical examinations of the employees and air analyses for benzol vapor indicated that the exposure was serious. Conferences among the printers, the ink manufacturers, and the N. Y. State Department of Labor, resulted in the production and use of benzol-free inks. Finding that the ink was not drying quickly enough to satisfy him, a plant foreman began to add benzol to the ink fountain. He had second thoughts while discussing the problem with an employee armed with a large pipe wrench. There is no doubt that labor in the country is generally intelligent and informed enough to want to help protect its health against occupational hazards.

Determining Factors

As previously indicated, the plant in which solvent-containing adhesives are used must be provided with ventilation to prevent possible toxic effect upon the employees. The kind and rate of ventilation which must be provided will depend on.

(1) The composition of the solvent.

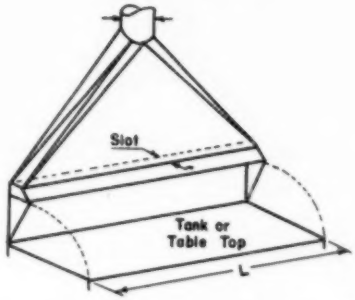
(2) The quantity of solvent evaporated in a given time.

(3) The method of application of the adhesive.

(4) The size of the material on which the adhesive is applied.

It is conceivable that in a plant in which not very much solvent is evaporated no mechanical exhaust ventilation need be provided. The workroom's volume can be calculated as available for initial dilution of the solvent vapor which is given off by the adhesive as it dries. In addition, it may be assumed that air leakage into the workroom will provide one to two air changes per hour even with windows closed.

Figure 2—Rear Hood for Tank or Table



Note: Duct diameter to maintain velocity of from 1500 to 2500 L.F.M. is recommended. Maximum width: four feet; maximum length of transition piece: four feet. More than one is to be used for larger hoods.

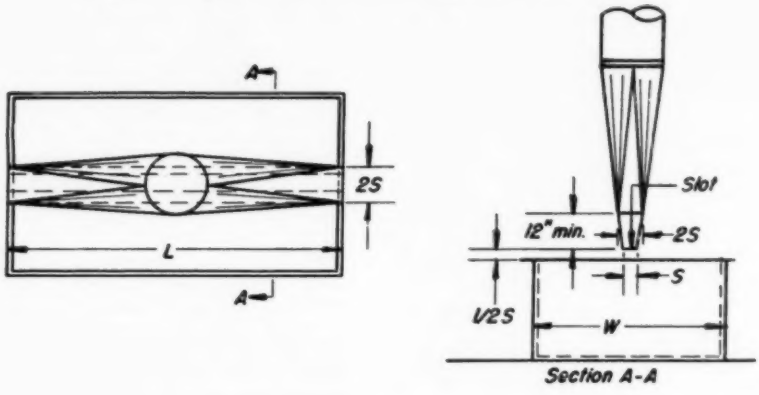
Using these data and the formula for general ventilation requirements previously given, one can calculate the volume of solvent which may be evaporated without providing other than natural ventilation. In making such calculations, the value of K in the formula should be taken as 10 since mixing of solvent vapor with workroom air is induced only by ambient air movement caused by temperature differences, and by the motion of people and machines.

Such mixing and dilution is less certain than that provided by mechanical exhaust systems. Naturally, only small volumes of relatively innocuous solvents may be evaporated into a workroom without providing positive means for the dilution or removal of the vapors.

As with adhesive manufacturing processes, adhesive spreading operations are best controlled by the use of local exhaust ventilation. This type of control is more efficient since the vapors are removed at the point of release. In addition, the cost is lower in the long run since smaller volumes of air may be exhausted for good control of the inhalation hazard.

A roller coating machine, such as is used in the shoe industry, will fit into a booth-type enclosure only slightly larger than the machine. Additional space must be provided for operator efficiency in handling the pieces to be coated. It must be remembered that adhesive-spread material is still wet when it is removed from the coating machine. These coated pieces must not be permitted to dry and evolve solvent vapors into the workroom air. The size of the

Figure 3—Slot Ventilation Along Center of a Table



pieces to be dried and the volume and composition of the solvent to be evaporated will be the criteria upon which the kind and quantity of ventilation to be employed must be decided.

If a booth is used for a roller coating machine, it is necessary to maintain an inward air velocity of at least 75 feet per minute—preferably 100 feet per minute—through the face of the booth. Baffles may be used to maintain an even flow of air through the entire open face of the booth. This results in a construction similar to that of a paint spray booth. However, the booth need not be as deep as one used in spraying since rebound is not a problem.

A common method for applying adhesives to flat objects is hand brushing. Unless minimal quantities of solvent adhesives are used, the preferred method for control is the use of ventilated tables. Generally, the size of the object to be cemented will determine the kind of table to be used.

Figure I, taken from the ACGIH Manual of Industrial Ventilation, shows a table which can be used on wide materials, up to the reaching distance by employees from both sides—about six feet. It is advisable to put coarse screening over the slots to prevent small pieces of light materials from being sucked in. The indicated ventilation rate is 50 to 100 cfm per square feet of table top. However, for a six-foot table the recommended ventilation rate is 150 cfm per square foot of table top area.

Tables which are no wider than four feet, and preferably not wider than three feet, may be ventilated along one edge. Figure II is an illustration from a New York State Department of Labor publication. The indicated ventilation rate (K) for spreading adhesives is 100 cfm per square foot of table surface. However, since adhesive spreading is accompanied by active motion of the employee performing the operation, it would be advisable to provide at least 150 cfm per square foot of table area. The use of end shields, indicated by dotted lines, will help prevent cross currents of air and will, therefore, provide better control.

Figure III, again taken from the ACGIH Manual, shows how slot ventilation can be used along the center of a table so that workers can brush narrower or smaller pieces from both sides. With this installation it would also be advisable to provide 150 cfm per square foot of table area. If possible, end shields should also be used.

If the table is more than about six feet long, one plenum should be provided for each four to eight feet of length. The ducts from the plenums should then be properly connected to a common header duct within which the air velocity should be about 2000 feet per minute.

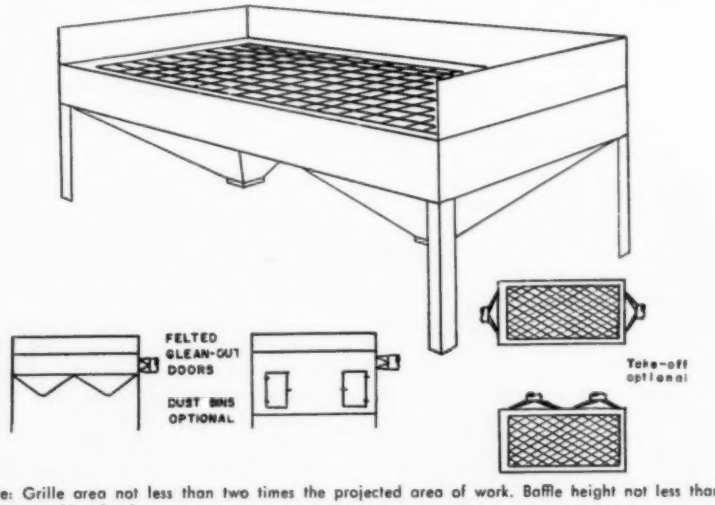
Irregularly shaped objects, rather than sheet material, may be coated with adhesives on a downdraft table such as is illustrated in Figure IV, N. Y. State Department of Labor. As the height of the object increases, the ventilation rate should be increased. The height of the baffles should also be raised.

Spreading adhesive or solvent cements on very large objects, such as balloons, is usually performed with general exhaust ventilation acting as the control procedure. The formula previously given for the calculation of the required ventilation rate is applicable in such a case.

A few final words about ventilation systems: no ventilation system will function properly unless it is well maintained. All parts must be cleaned periodically and frequently. Fan belts must be kept tight enough to prevent slipping. Grill work on slots and tables, or in front of fans for general ventilation, must be kept free of lint and other foreign materials so as not to reduce air flow.

Continued Next Month

Figure 4—Downdraft Table for Irregularly Shaped Objects



Note: Grille area not less than two times the projected area of work. Baffle height not less than highest working level.

Panel installation time cut 75 per cent by

Substituting Sealing Tape for Screws

By substituting a synthetic rubber sealing tape for the conventional mechanical fasteners used, contractors installing curtain wall panels for the new Delaware Valley Regional High School, Baptistown, N.J., were able to complete the job in about one quarter of the time that would be normally required.

The general procedure used with the type of porcelain exterior panels called for in the modern school structure is to set the panels in position with four aluminum snap beads requiring 12 screws. By using the sealing tape, however, the ironworkers were able to eliminate all use of screws. They merely put lengths of tape on the beads which were then snapped into place on each side of the green porcelain panels.

Developed by United States Rubber Co., the tape is designated as U-100 and has been field-tested for the past year. The long trial program is said to have uncovered many outstanding characteristics, such as excellent adhesion to a variety of surfaces, including glass, aluminum and brass; resistance to oxidizing; and virtually permanent flexibility. It is considered by many to be a major break-through in the construction field.

According to fabricators who have been using the tape for the past year, its ozone and weathering properties have been outstanding. Laboratory tests have demonstrated that it remains flexible at minus 76°F., and stable at continuous temperatures up to 150°F.

Exposure Tests

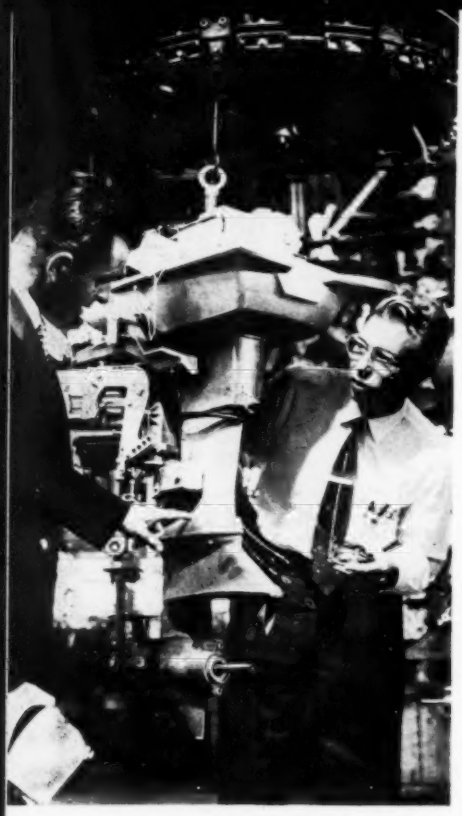
Exposed for many hours to ozone concentrations 15 times greater than the greatest known in this country—California and Washington, D.C.—the tape showed no signs of deterioration. Extreme weather conditions produced no appreciable loss in flexibility, and the tape showed neither shrinkage nor fatigue.

It is also being used where flexible gasketing and sealing is required, and as an anti-squeak buffer between metal panels.

After cleaning the surrounding area, a worker installs the surface-finished panel. The units are non-load bearing.

A length of the synthetic rubber sealing tape is applied to the aluminum snap bead on the job site.

Tape-spread aluminum strips are set in place on all four sides of the porcelain panel. Previously 12 screws were required.



McCulloch's Raymond Ranta, right, and Fuller's William Minarik inspect a Scott motor as it moves along the production line.

Epoxies on the Production Line

By RICHARD E. SMITH
Vice-President, Research & Development
H. B. Fuller Company

Adhesive supplier and company engineer cooperate to solve bonding problems

Research engineer Fred Caswell, of the Marine Products Division of McCulloch Corporation, Minneapolis, Minn., had experimented with epoxy resin adhesives in the lab and had observed on the assembly line the amazing ability of epoxies to weld dissimilar materials.

"Why not put together an entire Scott outboard motor with epoxy resin?" he asked.

Using an epoxy designated as Resiweld, Caswell and his team glued together about 75 per cent of a five horsepower Scott motor: the crankcase was glued to the block, the exhaust cover plate was glued to the block, the intake manifold was glued to the crank case, the carburetor and other small parts were glued to the intake manifold and to other portions of the engine.

Traditional bolting methods were used only in assembling the connecting rod caps and the cylinder head.

The glued motor was placed in a test tank where it ran successfully for half an hour. Engineer Caswell is convinced the motor would have run longer without failure had more care been taken in machining the motor parts surfaces. He labels the experiment as both interesting and satisfactory. With recent improvements in epoxy resins, a repetition of the experiment would undoubtedly be many times more successful.

McCulloch Corporation is not considering junking its regular assembly line methods in favor of a 100 per cent epoxy welding procedure. The experiment does demonstrate, however, that research engineers like Fred Caswell are thinking more and more about epoxies and how they can help lower production costs.

In the case of the McCulloch Corporation, the experiment proved beyond a doubt that the use of epoxies for certain steps in the assembly process was entirely justified —that further use of epoxies should be considered where it would do the job and save time.

McCulloch Corporation did have specific applications for which an epoxy adhesive seemed to be ideally suited. The introduction of process changes in the assembly line came about not only because of the strength properties of epoxy adhesive, but also because engineers employed by two different companies—the manufacturer and the adhesive supplier—were able to work together in common solution of problems as they developed.

First, was the water pump application. Scott motors are unusual in the industry in that they have two water pumps: one to bring water through the motor for cooling purposes and the other to bale water from the boat automatically. An epoxy was found to be an ideal adhesive for welding a stainless steel liner to the interior of a die-cast aluminum water pump housing.

A number of epoxy variations were tried. McCulloch Corporation liaison engineer Raymond Ranta and Fuller Company technical service engineer William Minarik conferred many times before the perfect combination was found.

Where epoxy is being considered for a specific assembly operation, the problem is to select the proper formulation. This involves exchange of information and test data between engineers and laboratories.

As a starting point, Minarik and Ranta filled in a service request form for Resiweld Adhesives and Plastic Alloys. This involves a complete description of the application, surfaces to be bonded, gauge or thickness of parts, special coating or sur-

About the Author . . .

RICHARD E. SMITH joined H. B. Fuller Co. in 1937 and has been research director of the company since 1941. The firm's Resiweld division was formed under his direction.

facing of the parts, surface pre-treatment and flexibility of the parts.

The engineers considered temperature extremes which would be encountered, not only during assembly, but in actual use of the manufactured product. The type of stress, contact with water or moisture and possible contact with chemicals also was considered and tested.

On the production line, the required pot life of the adhesive, the curing temperature and the time available are major factors.

Additional Considerations

In addition, these questions had to be considered:

How will the Resiweld be applied: by hand, by roll coaters or by press-feed applicators?

What physical property is most desired: very fluid, flowable, semi-flow resistant, or non-flowing?

How will the parts be held or jigged during the cure?

Is color a factor in the assembly? Will the joint be visible on the finished article?

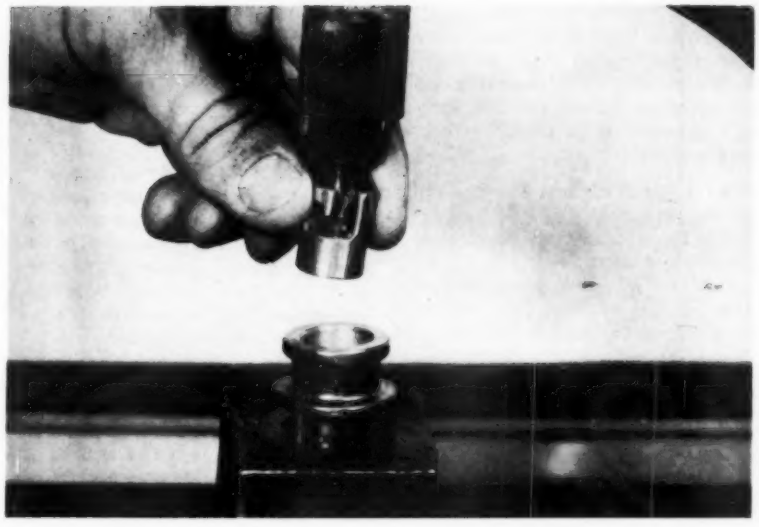
What are the price limitations?

Answers to these questions give Fuller Company chemists the information they need to formulate a tailor-made epoxy to meet the manufacturer's specifications which had been previously determined by actual engine operation in test situations. Test tanks are used to simulate use conditions; fresh water motor tests are conducted in the St. Croix River on the Minnesota-Wisconsin boundary; and salt water testing is done in Florida.

Engineers then check heat, vibration, shock loading and corrosion resistance of parts assembled with the recommended epoxy formulation. The water pump assembly is subjected to 1000 hours of salt spray and is then destroyed and examined for salt-resistance at the point of the bond.

During the testing period, Fuller Company engineer Minarik and McCulloch Corporation engineer Ranta worked closely. Their repeated conferences and discussions of problems and eventual solution of these problems resulted in less expensive, better procedures which enabled McCulloch Corporation to offer a better product on an intensely competitive market.

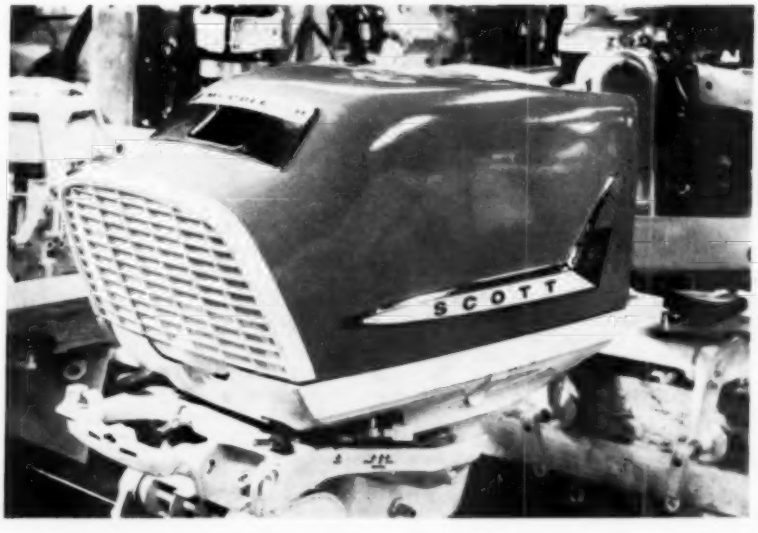
The association of these two engineers brought the solution to another production line situation—and did it cheaply: a ball check valve made from die-cast aluminum with a pressed-in, die-cast valve retainer.



In assembling the fuel line connector, top, adhesive is applied to the adapter and the housing containing the ball-check valve.

Center photo shows an adhesive-coated stainless steel liner for an outboard motor being pressed into the die-cast water pump housing.

An especially modified epoxy was needed to bond the acrylic plastic parts of the motor hood shown in the bottom photo.



Use of a heat weld would have distorted the housing, making the ball check valve inoperable. Research into this problem showed another Resiweld adhesive to be ideal for three basic reasons:

(1) Little or no heat was required for the weld.
(2) The adhesive was resistant to gasoline and oil.
(3) The adhesive made a neat joint—important since that part of the motor is exposed to view.

The fuel line connector application of adhesive is being used on Scott's entire line of motors—except the 3.6 horsepower motor, the smallest in the McCulloch Corporation line. The use of adhesive bonding in the fuel line assembly has cut costs considerably, according to Ranta.

Top Hood Application

Versatility of resin-type adhesives in manufacturing is demonstrated by use of Resiweld for the top hood application on the Scott motor. A die-cast aluminum front housing is glued to a fibre glass top hood. A tongue and groove joint is provided to allow maximum adhesion surface.

A special problem arose in this application and the solution was worked out through close cooperation between the engineers of the two companies. Resiweld worked well in assembling the aluminum housing and the polyester fiber glass hood. When Scott introduced an acrylic plastic top hood, an adhesive giving better bond strength to this difficult-to-weld plastic was needed. Fuller Company chemists developed a modification of the resin adhesive which was unique in that it provided specific adhesion to acrylic plastic. The latter cannot be bonded by ordinary epoxy adhesives.

Executives of the two firms are of the opinion the McCulloch Corporation-H. B. Fuller Company experience is an example of intercompany cooperation which is today producing finer manufactured products at lower cost to the consumer.

Adhesive-Mounting a Cultured Pearl

1 In New York City's exciting Jeweler's Exchange, a customer can have the pearl of her choice mounted in the setting of her choice while she waits. Here expert Max Mermelstein prepares cultured pearl by drilling a "peg" hole.

2 A special pearl cement consisting of a basic adhesive compound and a hardener, or curing agent, are mixed together in a watch crystal. A tiny metal spatula is used and care must be taken not to get any adhesive on the skin.

3 The pearl adhesive is applied to both the cultured pearl itself and the metal setting. No heat or pressure is needed to cure the unit. Here two completed pearl clips are inspected by a customer. Total elapsed time: 20 minutes.

By E. PATRICK McGUIRE

Overgrading

A dollars and sense analysis shows that in many cases multiplication of adhesive grades leads to duplication and cuts into the manufacturer's over-all profit

The term "overgrading" is of very real economic significance in the adhesives industry. Very simply stated, overgrading indicates a management situation in which the existence of a multiplicity of product grades actually reduces rather than enhances the firm's profit structure.

This description is of necessity an oversimplification of a complex management problem. It does, however, strike at the heart of this dilemma—the reduction of potential profits. In the following paragraphs we shall seek to examine the origins and ramifications of overgrading.

The early economic history of the adhesive industry was one of relatively steady growth. The manufacturer produced a small variety of adhesives that were satisfactory for the limited industrial scheme that confronted him. Many adhesives were of the all-purpose variety and consequently used on a wide range of industrial applications (witness the early industrial applications of animal glue).

The advent of World War II and the superimposition of an expanding plastics technology on an already burgeoning technical economy wrought radical changes in this picture. With the growth of the plastics technology came a greatly increased source from which to draw adhesive formula components. At practically the same juncture, bonding-machine design was undergoing a similar change. New machines demanded special adhesives because of their individual peculiarities revolving about new methods of applying the adhesive and more stringent requirements with regard to bonding speeds and finished bond strengths required by some end-products.

The new machines and the new films, foils and papers of the packaging industry posed an important problem to the adhesives producer, who responded naturally enough with a multitude of extremely specialized needs adhesives to meet these specialized needs. The last few years have given no indication that this trend is letting up. As a matter of fact, within the past two years the industry has probably produced more new formula grades than in the five year period immediately preceding.

Operations Impeded

Admittedly this is an age of acute specialization and this trend fits in with the general industrial pattern. However, some adhesive producers have carried product specialization past a reasonable juncture and to the point that it actually impedes their operations and restricts their profit potential.

As is the case with many industrial producers, the adhesive manufacturer, although vaguely aware of his supply curve characteristics, is nonetheless almost completely in the dark when attempting to define the demand curve that faces his firm or his industry. A basic economic tenet is that market price is created by the equilibrium established between supply and demand. Figure 1 is a simple graphic illustration of how these interacting functions establish a market price for an imaginary adhesive grade. The problem that faces the adhesive producer is, as we have noted, that he has very little inkling of the actual characteristics of line *D*, the demand curve.

Faced with such a situation the adhesive manufacturer may respond with a widening range of adhesive grades, many of which may perform nearly identically. This reaction may arise out of the belief that a broad product diversification and specialization will produce a semi-shield against direct adhesive grade competition by competitors. The producer feels that the aggregate of a number of buyers purchasing specialized adhesives will outweigh the production advantage of grade standardization.

In some instances this feeling may be justified. It is evident, however, that much of this competitive advantage is negated when the industry in general or several major competitors alter their marketing policies to meet this situation.

Coupled with the adhesive producer's inability to assay the demand curve facing his firm is the relative inelasticity of demand. There are instances, where an elastic demand curve exists, in which a price reduction will stimulate consumption of the product under examination. However, by and large this situation does not exist in the adhesive industry.

A price reduction may result in

a temporary market advantage for the firm since it garners some of its competitors business. But such action is usually met by similar reductions in the price levels of competitive adhesive grades. The end result is a gradual diminishment of profit margins for all producers of the grade involved. The market then swings back to an equilibrium point nearly identical to the pre-pricecut distribution pattern.

Product Research

Faced with these facts, the intelligent producer responds with an ever increasing emphasis on product research. He attempts to establish a time-lag situation in which he can reap the profits of a new innovation unencumbered by the leveling influence of pressing competition. In this process, the research arms of the corporation naturally spew out a greatly increased array of product grades. From one point of view we might view this reaction as eminently satisfactory because it stimulates research and national growth. It does, however, pose some serious management problems.

To begin with, perhaps not more than one out of five grades released by the laboratory really catches on and sells in such quantity that it can be considered a true profit item. The remaining four grades find some strange destinations. Two or perhaps three of them prove unacceptable in a relatively short period or undergo rapid technological obsolescence and are consigned to the laboratory archives. These grades are relatively harmless to the organization since they never actually go into production. The experience gained in their formulation and testing has actually been beneficial.

Profits Drained Off

It is the remaining grade that goes into partial production that poses the real dilemma. This is a point where potential profits can quietly and slowly leak away. For the moment, for the purposes of identification let us designate this particular grade as *Grade X*.

Grade X comes into existence because of the need for a specialized adhesive. At its birth the development arm of the corporation is assured that this baby will grow to a veritable giant. The grade is produced and sold. Then, something happens to stunt the grade's growth.

Perhaps the operation it is to be used on becomes obsolete or the sales department loses the account. In any case, for one or a host of reasons the usage level of this grade never grows to a satisfactory production level. The demand for the grade becomes sporadic and production intervals on the grade stretch out. Instead of a giant we find ourselves saddled with a white elephant.

There are many interesting consequences to Grade X's existence. Perhaps the accounts calling for the product order in lots that do not correspond to production batch sizes. The producer is forced to manufacture an excess and store the difference between orders. Invariably, over-age products accumulate that must be either blended back into new batches or discounted and sold at a loss. It is nearly impossible to obtain an exact definition of the extra production costs that are thus entailed.

Concurrent with this manufacturing difficulty is the problem of maintaining adequate stores of raw materials for the production of Grade X. If this grade is now established at a reduced production level, the manufacturer will be forced to limit the size of his raw material purchases. With this limitation come transportation and supply problems and the disappearance of quantity discounts. These factors distort the supposed profit margin on this grade.

Most adhesive producers are faced with positive limits on the size of the physical plant involved and the production capabilities of the labor force employed. The very inflexibility of these physical assets should of itself provide the major rationalization for a sane product arrangement.

We may correctly assume that each adhesive producer does have an *average cost per unit of production*. To be sure, some adhesives because of manufacturing peculiarities do have costs which are higher than others. This fact acknowledged, we may nevertheless arrive at an *average total cost*.

Average Total Cost

In analyzing the effect of overgrading on this *average total cost* we will for the moment consider the physical plant of the producer to be within rigidly fixed limits. That is to say that he will have pre-arrived estimates as to his storage and production space. In this analysis we will also consider the *average fixed costs:* rents, depreciation, etc. We will likewise evaluate the *average variable costs* of the producer: labor, materials, etc.

Figure 1—Hypothetical Example of How Supply and Demand Create an Adhesive's Market Price

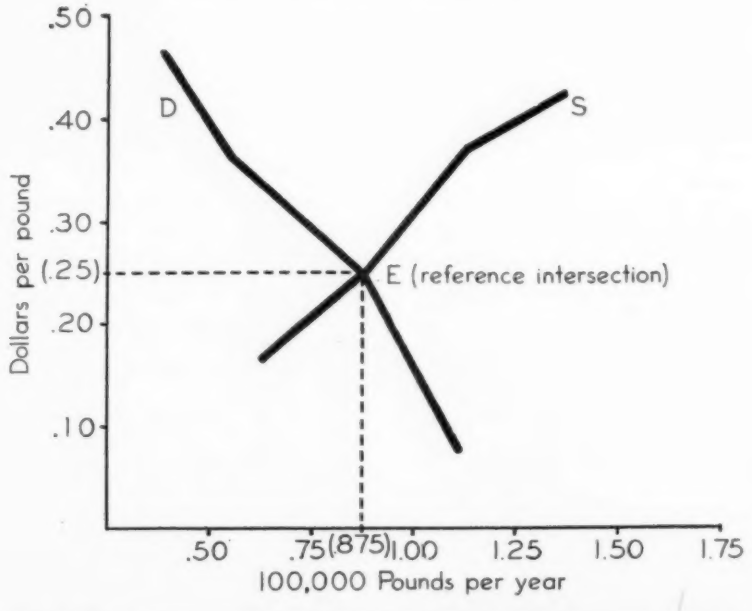
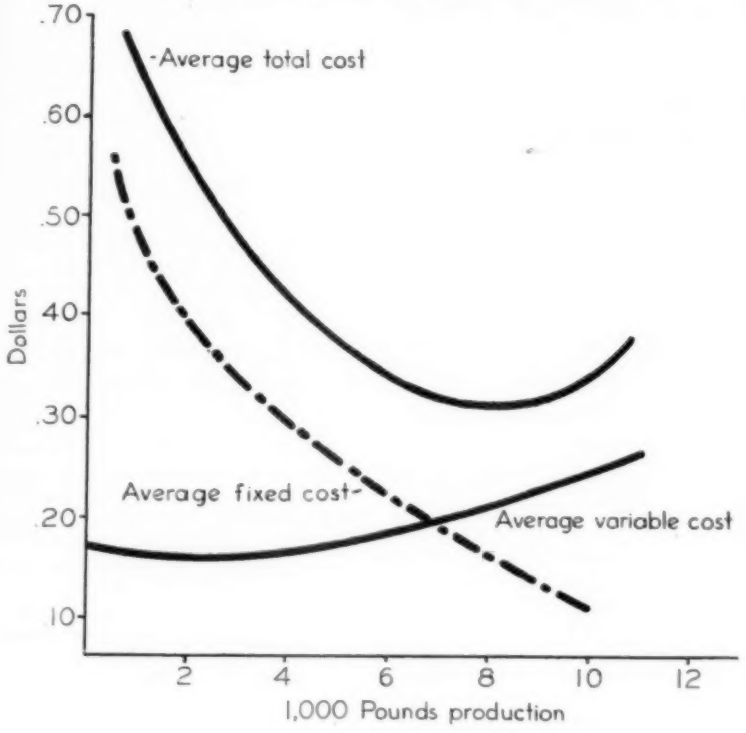


Figure 2—Average Cost Relationship at Increasing Levels of Production with Fixed Physical Assets



Under an oft-cited production scheme, the manufacturer's *average total cost* will decrease steadily as his production increases and the fixed costs take a smaller and smaller bite out of the unit costs. There is, however, a level of production or of grade specialization at which *average total cost* will actually increase due to the physical limitations of the existing manufacturing plant. Simple expansion of the plant will not of itself return these costs to their lowest levels.

Limited Plant Space

Figure 2 shows the hypothetical reaction of the three cost curves to increased production with inelastic plant dimensions.

Under the extremely similar circumstances of overgrading we will get a nearly identical disposition of the *average total cost*. This graph then illustrates that in some respects the producer would be wiser to select a lower level of production, eliminate overgrading by standardizing his adhesive grade structure, reduce his *average total cost*, and realize greater profit per unit.

Old and obsolete adhesive grades like old shoes resist the best intentioned efforts to discard them. It is very likely that within the recesses of some sales or development executive's brain rests the fond hope that despite all, some day Grade X is going to begin paying its way. In the vast majority of cases these hopes are ill founded.

Despite the lip service this person pays to American mass production techniques, he would nevertheless prefer to cling to the vestiges of a craft-guild individually tailored economy.

Obviously many adhesives must be tailored to particular customer specifications and this in our present state of industrial development is a very natural occurrence. The writer does however believe that the manufacturer, in fairness to himself, must look very critically at the short term and long term volume potential of the grade under consideration.

Acknowledging that overgrading does exist to variant degrees throughout the adhesive industry we may now turn to some proposed remedies to this situation. The following are but a few steps in a broad program that can be initiated within the organization to curb the growing threat of overgrading.

Program Outline

(1) Periodic review of the actual sales of each adhesive grade and the elimination of marginal products for which demand has evaporated or which have experienced technological obsolescence.

(2) Review of formulary ingredients with a view to standardization of as many as possible proprietary additives: defoamers, preservatives, etc.

(3) Standardization of container sizes and specification types to eliminate container inventory and storage problems.

(4) Standardization of label forms and labeling procedures.

(5) Survey of variant compounding techniques with a view to standardization and utilization of single larger size production units.

(6) Where it is necessary to produce a highly specialized grade, an accurate cost analysis for the product should be performed. The market price should reflect the real additional cost to the producer for the manufacture of this grade.

To be sure, the above suggestions are only the simple first steps of what is essentially an extremely complex management procedure. It has been thought that the major emphasis for this change in policy must be directed to the grass-roots level of the individual adhesive sales representative. A realization of the problem at this level will check to a large degree the chain of circumstances that produces overgrading. The salesman armed with an effective arsenal of tried and dependable grades is in a much more secure market position than the competitive representative burdened with five thousand adhesive grades none of which he is really sure will perform.

Faced with rising labor and material costs the adhesive manufacturer may well find himself in the paradoxical position of actually having to refuse some business in order to retain a sane and sensible grade and profit structure. However, unless he assumes such a position, he may well overgrade himself right into oblivion.

NEWS of the ADHESIVES WORLD

14 Papers Presented At Bonding Symposium

Technical Association of the Pulp and Paper Industry held a Fiber Attraction and Bonding Symposium on September 9-11 at the Institute of Paper Chemistry in Appleton, Wisc. Over 200 persons attended the three day Symposium which featured the presentation of 14 papers. The papers were given in five sessions, they were:

Session 1, Principles of Adhesion —"Fundamentals of Adhesion" by Alfred H. Nissan (Rensselaer Polytechnic); and "Structural Aspects of Bonding" by J. A. Van den Akker (Institute of Paper Chemistry).

Session 2, Development of Wet Web Strength—"Fiber Agglomeration and Dewatering" by W. L. Ingmanson and S. T. Han (Institute of Paper Chemistry); "Wet Web Strength" by W. Brecht and H. Erfurt (Institut fur Papierfabrikation, Technische Hochschule, Darmstadt, Germany); and "Some Aspects of Wet Web Behavior" by A. Robertson (Pulp and Paper Research Institute of Canada).

Session 3, Fiber Properties Affecting Adhesion—"Flexibility of Fibers" by S. F. Kurath (Institute of Paper Chemistry); "Dimensional Stabilization of Paper" by W. E. Cohen, A. J. Stamm and D. J. Fahey (U. S. Forest Products Laboratory); and "Fiber Geometry as Related to Adhesion" by Renata G. Marton (College of Forestry, State University of New York).

Session 4, Development of Bonds —"Mechanism of Bonding" by W. Boyd Campbell (consultant); "Fiber Surface Area and Bonded Area" by J. W. Swanson (Institute of Paper Chemistry); and "Bonding in Synthetic Fiber Papers" by R. A. A. Hentschel (DuPont).

Session 5, Role of Additives in Bonding — "Polysaccharide Adhesives" by M. L. Cushing (A. E. Staley); "Mechanism of Retention of Resin Additives" by E. F. Thode, J. W. Swanson and S. F. Kurath (Institute of Paper Chemistry); and "Elastomeric Binders" by Paul J. McLaughlin (Rohm & Haas).

Tooth Glue

A tooth glue that might eventually eliminate the need for dental plates and bridges has been developed by United States Navy medical researchers. According to reports, the development offered the possibilities of taking a tooth out, filling it and placing it back; extracting teeth that need straightening and gluing them back in neat order, and perhaps repairing broken bones.

Experiments with dogs indicate that after a tooth is pulled, the original tooth or an artificial substitute can be inserted in the socket with the new cementing substance. An extracted tooth would be dead when re-inserted. No dental glue studies have been made on humans and the Navy is not making any claims that the technique will work on man, however, the animal work looks very promising for human application, the Navy states.

The glue is composed of materials that make up human bone, including calcium, phosphorous and glycogen. The basic material is in liquid form, but a resinous polyester material is added to convert it to a solid. Certain catalysts are also added to make the material set quickly after the tooth is embedded in it.

Symposium on Sealants Planned by SAMPE

The Society of Aircraft Materials and Process Engineering will hold a Symposium on Sealants and Sealing of Aircraft, Missiles, and Electrical Components on October 28-30 at the Institute of Aeronautical Sciences in Los Angeles, Calif. The meeting dates are concurrent with the Aircraft Electrical Society Show which will be held at the Pan Pacific Auditorium in Los Angeles. The Symposium has been two years in the planning and is the culmination of the efforts of hundreds of technical men in the aircraft and missile industries. These include those who design systems to be sealed as well as those who design sealants, both civilian and military.

Papers to be presented during the three day program are: *October 28, Morning Session*—"USAF Polymer and Sealant R and D Program" by Lt. Col. R. W. Connors (Air Research & Development Command); "Environments, Properties of High Temperature Sealing Compounds, Room Temperature Curing System for Fluoroelastomers, and New Experimental Polymers for Sealing Applications" by Philip A. House (WADC); and "Development of Elevated Temperature Sealants Accomplished under WADC Contract" by William A. Cheorvas (Products Research Co.).

Afternoon Session—"Compatibility of Sealing Materials to Missile Fuels and Oxidizers" by Marco Petronio (Frankford Arsenal); "High Temperature Sealants for Protection of Structural Plastics against Oxidative Degradation at High Temperature" by F. Caludi (Magnusson-Narmco Industries); "Development of High Temperature Resistant Coating Sealant for Aircraft Fuel Tanks" by John Vanderbur (North American

Aviation); "Recent Developments in Polysulfide Polymers" by Morris B. Verendaum (Thiokol); "Present and New Developments in Urethane Elastomers" by R. C. Buck (Mobay); and "Environmental Testing of Sealant Systems" by John Middleton and Gordon Lindner (Minnesota Mining & Mfg.).

Evening Session—"Current Developments and Future Developments in High Temperature, High Performance Sealants Based on Silicone Polymers" by R. R. Maneri (Dow Corning); "Di-Cure of RTV Silicone Sealants" by C. Wing (Boeing Airplane); "The Use of Room Temperature Curing Silicone Rubbers for High Temperature Aircraft Sealing" by Mal Clancy (North American Aviation); and "Effect of Nuclear Radiation on Sealants" by R. Siebert (Douglas Aircraft).

October 29, Morning Session—"Introduction to Electrical Sealing" by Comdr. Glen Herndon (U. S. Navy); "Electrical Properties of Polymers in Extreme Environments" by Gene M. LeFave (Coast Pro-Seal); "The Use of Polyurethanes in Electrical Sealing" by C. A. Berridge (General Electric); and "The Place of Epoxy Sealants in Electrical Sealing" by Joseph Philipson (Atlantic Research).

Afternoon Session—"Castable Elastomers in Cable System Design" by Robert Gamero and Gene LeFave (Coast Pro-Seal); "Corrosion Effects of RTV Silicone Compounds" by H. F. Click and R. Hunter (Northrop Corp.); "Environmental Problems in Missile Electrical Systems" by R. Frak (Douglas Aircraft); "Introduction to Airframe and Missile Sealing" by Richard Battle (Douglas Aircraft); "Static and Dynamic Sealing for Temperatures to 1000°F." by W. Mayhew (Republic Aviation); "Tadpole Seals, Their Components, Design, and Use" by R. L. Holmes (Raybestos-Manhattan); and "Seal Design" by A. S. Kidwell (Connecticut Hard Rubber).

Evening Session—"Evaluation of B-52 Integral Fuel Tank Sealing" by C. Johnson (Boeing Airplane); "Sealing of the B-58 Hustler Airplane" by D. J. Pritchard (General Dynamics); and "Faying Surface Sealing of the C-130 Hercules with Semi-Cured Polysulfide Film" by L. D. Rogers (Lockheed Aircraft).

October 30, Morning Session—"Design for Fluid Tightness" by R. C. Hempstead (WADC); "Design Philosophy for the Prop Jet Electra Airplane" by F. A. Alonso (Lockheed Aircraft); "Structural Adhesives Seal Integral Fuel Tanks" by J. R. Spurgeon (General Dynamics); and "Sealing of Space Capsules" by E. K. Welhart (McDonnell Aircraft).

Afternoon Session—Panel Discussion by Airframe, Missile and Military Personnel, moderated by R. B. Jackman (Northrop Corp.) and Lt. Col. H. C. Hamlin (WADC). The panelists will be: Howard Atkins (North American); E. P. Troeger (Douglas Aircraft); George W. Papen (Lockheed Aircraft); Paul R. Stone (U. S. Navy, Bureau of Aeronautics); Lt. Col. R. W. Connors (Air Research & Development Command); Seth Gunthrop (General Dynamics); William L. Machin (Pacific Missile Testing Range); and a representative from the Redstone Arsenal.

FMC Appointments

Food Machinery and Chemical Corp., New York, N. Y., has appointed R. H. F. Dade as general manager of a new chemical facility which the company will design, construct and operate for the Army Chemical Corps at Newport, Ind. Mearlin L. Sims, plant manager of FMC's Nitro, West Va. plant, has been named resident manager and will be succeeded at the Nitro unit by Leonard G. Nussbaum, production manager of the firm's Baltimore, Md., plant. Mr. Dade, who is a vice-president of the Chemical Division, was previously assistant manager of the Organic Chemicals Department. Before his present appointment, Mr. Sims spent two years as resident manager of the Nitro, West Va., plant of FMC's Chemicals and Plastics Division.

Adhesives Symposium

Quantum, Inc., Wallingford, Conn., will hold its semi-annual symposium on Thursday, November 19, at the Yankee Silversmith Inn in Wallingford. The theme of the symposium will be "Adhesion and Adhesives in Industry." According to Quantum, experts will discuss the broad area of adhesives . . . what they are, how they can be used to improve products and reduce costs, and solve design and production problems. An after-dinner talk will emphasize future trends in adhesives. Additional information about the symposium can be obtained from Quantum, Inc., Lufbery Avenue, Wallingford, Conn.

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BRI Fall Conferences

Methods for keeping in step with the vast production of building science research literature currently published throughout the world and for making new knowledge more conveniently available, will be one of the subjects under discussion at the Fall Conferences of the Building Research Institute to be held on November 17-18 in Washington, D.C. Charles H. Topping (DuPont), past president of BRI, will head up the sessions to review the documentation and cataloging of this constantly growing store of information, and leading workers in this field will report on their activities in classification, indexing and organization.

A major program at the conferences will be devoted to the Design Potential of Metal Curtain Walls. This has been set up by a joint BRI-American Institute of Architects Committee headed by C. E. Silling (FAIA) and Herbert F. Johnson (ALCOA). Discussions will analyze past failures with metal curtain wall construction and will be directed toward new creative applications, from the standpoint of fabrication possibilities, tolerances, supervision, field erection problems and specifications standards.

Also on the agenda is a conference-workshop program on sandwich panel design criteria, which will be headed up by Dr. Albert G. H. Dietz (MIT). All types of sandwich panels and materials . . . plastics, wood, metals, concrete and paper . . . will be considered by specialists from various parts of the country. The sandwich panel workshops will be headed by John S. Parkinson (Johns-Manville), George W. Koehn (Armstrong Cork), John K. White (American Houses), Walter E. Voisinet (National Gypsum), and R.L. Hildebran (U.S. Plywood).

Benson Named Agent

Shawinigan Resins Corp., Springfield, Mass., has appointed W. Ronald Benson, Inc. of Seattle, Wash., as its sales agent in Washington and Oregon. The Benson organization will handle the sales of Shawinigan's entire product line of polyvinyl resins and emulsions and will also supplement Shawinigan's technical service to its customers in the Pacific Northwest. Shawinigan will continue to maintain warehouses in Portland and Seattle and sales offices in Los Angeles and San Francisco. Benson, with headquarters in Seattle, also maintains offices in Portland.

Max Anning

Named By Roberts

The Roberts Co., City of Industry, Calif., has named Max Anning as head of its newly formed Product Development Division. According to the company, Mr. Anning will embark upon a continuous study of new products in the adhesive bonding and chemical fields, and help to launch an all-out development program to establish the new products as additions to the company's current line. The Product Development Division is the result of the acquisition by Roberts of the Anchor Chemical Co., creators of Anchor-Weld Contact Cement. The purpose of the division will be to develop new products to add to the current line.

Mr. Anning's new post climaxes a 15 year career in engineering and products, the last five years spent with the Roberts Co. Mr. Anning presently is active on the Licensing & Diversification Committee of the Los Angeles Chamber of Commerce.

NAFM Convention

The National Association of Furniture Manufacturers held its 31st Annual Convention on August 29-September 1, at the Conrad Hilton Hotel in Chicago, Ill. The convention coincided with the NAFM 5th Annual Supply, Equipment and Fabric Fair. Over 2,000 furniture manufacturers attended the combined convention and fair and examined the products and services of some 125 exhibitors. Included in the exhibits was a line of wood treatments for stabilizing and preserving woods which was shown by National Casein Co., Chicago, Ill. The firm also showed its line of glues. Franklin Glue Co., Columbus, Ohio, exhibited a new line of production materials called Multibond Adhesives.

BRAB Appoints Officers

William Gillett, vice-president of Fenestra, Inc., has been appointed to a second term as chairman of the Building Research Advisory Board. Serving his second term as vice-chairman will be Richard H. Tatlow III, president of Abbott, Merkt & Co. BRAB has also announced the appointment of six new members to its board, including Frederic M. Babcock (Frederic M. Babcock); Max Barth (Office of the Assistant Secretary of Defense, Department of Defense); Peter B. Gordon (Wolff & Munier and John B. Pierce Foundation); Raymon H. Harrell (Lumber Dealers Research Council); Dr. Ernest Weissmann (Bureau of Social Affairs, United Nations); Thomas E. Werkema (Dow Chemical). Harry B. Zackrison, Sr. (Office of Chief of Engineers, Department of the Army) was reappointed for another 5 year term to the board.

The Building Research Advisory Board, a unit of the National Academy of Sciences-National Research Council, operates under the Division of Engineering and Industrial Research. Membership of the 30 man board is drawn from the leading scientists, engineers and technologists in government, academic and research institutions, and industry. BRAB may stimulate and correlate research activities and may study, on request, any subject of science or technology in its field and advise on questions submitted by any department or agency of the Federal government, or by other sources when in the public interest.

Awarded Patent

Patterson-Kelley Co., Inc., East Stroudsburg, Penna., has been awarded a patent for its Liquid-Solids blender by the United States Patent Office. The patent, No. 2,890,027, relates the blender specifically "to improvements in machines designed to wet or moisten dry powdered materials such as are normally considered to be immiscible because of their tendencies to ball up and 'lump' when coming in contact with small streams or droplets of liquids." The patent was granted to John J. Fischer, assignor to Patterson-Kelley and chief engineer of the firm's Process Equipment Division. The Liquid-Solids blenders manufactured by the company range in size from one quart to units of 800 cubic feet or more, and are constructed of clear plastic, stainless steel, or coated and uncoated carbon steel.

Many New Products At Chemical Exposition

The 27th Exposition of Chemical Industries, to be held from November 30 to December 4 at the New York Coliseum in New York City, will feature many exhibits with direct applications in the rapidly expanding fields of missiles, nucleonics, electrochemicals, petrochemicals and ceramics. Other exhibits will apply to associated industries whose products depend on chemical processes, as do the food industries, biologicals, pulp and paper, textiles, paints and varnishes, soaps and detergents and cosmetics.

A noteworthy factor in this year's display will be the heavy emphasis that exhibitors will place on more highly resistant chemical processing equipment. This will be evident at all stages from the raw and fabricated materials through specialties to the complete units which will be on display throughout the Exposition.

A majority of the displays in the Coliseum will consist of equipment for preparing, combining and treating materials by conventional methods, but as conventions change, processes are intensified and new designs are evolved. Therefore much of the processing equipment on view this year will be new.

New, too, will be a number of methods for determining the condition of materials in process. One exhibit will demonstrate the application of viscometers to such uses as the automatic addition of solvents to correct for evaporation losses in finishing, sizing and coating operations, and to determine the end point in polymerization processes, as well as in starch cooking, and blending petroleum products.

A number of equipment items have been developed for relatively new process applications. One such is a line of changeable can mixers with tight covers for mixing under vacuum. Another is a line of vacuum mixers and extruders, designed to densify and improve the strength properties of the product.

Polyfibron Laboratory

Dewey & Almy Chemical Division of W.R. Grace & Co., Cambridge, Mass., has announced that its new Polyfibron laboratory at Cambridge is nearing completion. When completed, the laboratory will contain pilot scale facilities for making, impregnating and coating papers.

John M. Coffey

Robert S. Forsyth

National Starch Promotes Two

National Starch and Chemical Corp., New York, N.Y., has announced the promotion of John M. Coffey and Robert S. Forsyth to senior development chemists in its Adhesive Technical Development Group. Mr. Coffey graduated from Tufts College with a B.S. degree in chemistry. He joined National Starch in 1953 and spent his first year in resin research, and later transferred to technical service at National's Alexander Laboratories in Plainfield, N.J. Mr. Coffey went to Chicago in 1957 to continue his activities in adhesive development and field service with the company's Midwest Adhesive Technical Development Group.

Mr. Forsyth received a B.S. degree in chemical engineering from Lafayette College and an M.S. degree in industrial management from Stevens Institute of Technology. He joined National Starch's Adhesive Technical Development Group in 1952.

Appointed Agent

T.C. Ashley & Co., Inc., Boston, Mass, has been appointed exclusive selling agent in New England and New York for phenolic resins and molding compounds made by Firestone Rubber & Latex Products Co., Fall River, Mass. The Ashley company will cover the shoe trade, paint and varnish trade, paper field, electronics field, lumber industry, brake lining industry, and molders of phenolic compounds.

Dow Income Up

Dow Chemical Co., Midland, Mich., reports that its earnings after taxes for the fiscal year ended May 31 amounted to $62,916,016, equal to $2.39 per share of common stock, compared with $46,059,181, or $1.78 per share for the like period a year ago. Net sales for the 1958-1959 fiscal year totaled $705,442,403, compared with $636,201,143 for the 1957-1958 fiscal year.

Reichhold in Vienna

Reichhold Chemicals, Inc., White Plains, N.Y., has announced that Beckacite Resin Ltd., Vienna, Austria, recently restored to its owners, has been converted into a publicly owned company under the name of Reichhold-Beckacite A.G. According to the company, this brings to 19 the number of foreign countries in which RCI has affiliated or associated companies producing the firm's line of basic chemicals, synthetic resins and other products. Henry H. Reichhold will be board chairman of the new company. Other executives include Harald List, Dr. Friedrich Stimler and Dieter Hamann, manager. The company reports that expansion is being planned for Reichhold-Beckacite A.G. and will include modernization of existing facilities and increasing its capacity. In addition, new types of synthetic resins and basic chemicals will be produced, as well as the establishment of a new research laboratory, the company states.

R. B. Rohrer

J. E. Hazeltine

B. R. Billmeyer

Armstrong Management Changes

Armstrong Cork Co., Lancaster, Penna., has announced eight changes in its management organization which are designed to give emphasis to new product development. R. B. Rohrer, previously assistant director of research, has been named associate director of research. Mr. Rohrer will share with F. B. Menger, director of research, the over-all responsibility for the administration of the firm's Research and Development Center. Mr. Rohrer will also assume the direction of physical and chemical research as well as administering outside research projects carried on by universities and other institutions.

The company also named two new assistant directors of research. They are J. E. Hazeltine, in charge of divisional research, and B. R. Billmeyer, in charge of research administration. Mr. Hazeltine, formerly head of plastic flooring products research, will direct and coordinate the research and product development work of the four divisional research groups responsible for building, floor, industrial and packaging materials products. Mr. Billmeyer, previously head of industrial products research, will handle all business and personnel administration for the Research and Development Center.

Armstrong also announced that R. A. Garrett, formerly manager of rubber products research in the Industrial Products Group, succeeds Mr. Billmeyer as general manager of industrial products research. A. H. Johnson has been named to replace Mr. Garrett as manager of rubber products research. Mr. Johnson formerly was in the Plastics Research Department. D. T. Zentmyer, who was a member of the Plastics Research Department, will succeed Mr. Hazeltine as manager of plastics flooring research in the Floor Products Group.

H. C. Brown has been appointed general manager of special products, reporting to the director of research. Mr. Brown will continue to serve as a member of Armstrong's residential building task force. G. W. Koehn has been appointed general manager of consumer products research, reporting to the director of research. Mr. Koehn will continue as assistant manager of the Consumer Products Department.

Fair in Germany

"Kunstoffe 1959", the 3rd International Fair of the Plastics Industry, will be held on October 17-25 in Dusseldorf, Germany. The 1959 display will comprise the products of 15 countries representing over 700 exhibitors from Europe and overseas. The exhibition is expected to demonstrate the extent to which plastics have found a place in technological uses such as construction elements in machinery applications, electro-techniques, automobile production and similar end uses. One quarter of all the exhibiting firms will come from the engineering industry and the many facets of automation will be featured. The Fair will also demonstrate on what machines and by what means new plastics recently developed are best converted.

The Fair will also serve as a meeting place for plastics experts and scientists since the 8th German Plastics Convention will be held to coincide with the exhibition. In addition, an international symposium on the aging of plastics will be presented.

New Borden Unit

Coatings and Adhesives Department of the Borden Chemical Co., New York, N. Y., has announced that a half million dollar plant at Illiopolis, Ill., is expected to be completed and in production by October 1. The new plant with 24,000 square feet of floor space, stands on a 40 acre plot where the firm also has major facilities for the manufacture of polyvinyl acetate, polyvinyl chloride and butadiene-styrene emulsions. Production will include Borden's full line of industrial coatings and finishes, adhesives, plastisols, hot melts, flooring mastics, underlayments, asphalt emulsions and other building materials products for distribution in Chicago, St. Louis, Detroit, Kansas City and other Midwestern cities. Designed by Borden engineers, the new plant provides facilities for general manufacturing, warehousing, solvent solution, processing, offices and a tank farm for raw materials storage.

Edwin Stein Dies

Edwin Stein, chairman of the board of Stein, Hall & Co., Inc., New York, N.Y., died suddenly on August 31 in Lenox Hill Hospital, New York. He was 64 years old. Mr. Stein, a graduate of Yale University, had been associated with Stein, Hall for 43 years. He was elected president and director of the company in 1944, and chairman of the board in March 1948. In 1950, shortly after the start of the Korean conflict, he was appointed consultant for the adhesives industry to the Plastics Branch of the Chemical Division of the National Production Authority. Mr. Stein was a member of the Yale Club and the Chemists Club. He is survived by his wife, two sons and two daughters.

Ferri Joins Dunkel

Paul A. Dunkel & Co., Jersey City, N.J., has announced that Charles M. Ferri has joined its staff as sales and technical director. Mr. Ferri will be in charge of quality control, new product development, and technical service. Mr. Ferri attended St. John's University where he received his B.S. and M.S. degrees. He has also done graduate work at New York University. Prior to joining Dunkel, he was affiliated with Thurston and Braidich for 15 years as technical director.

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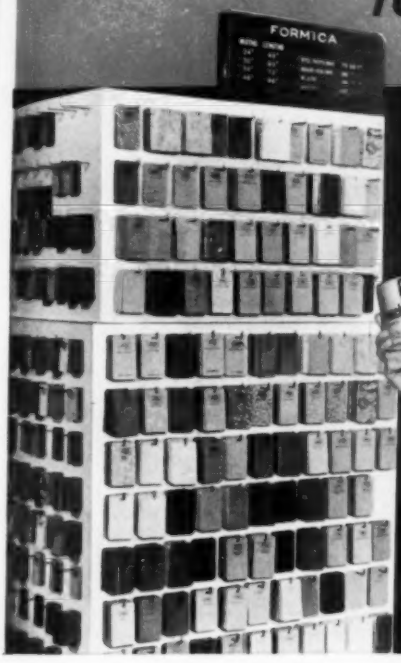

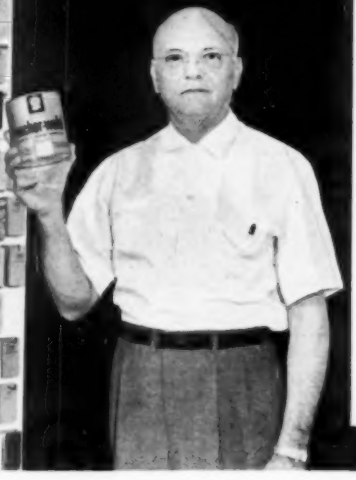

"With the type of laminates I use, I can't afford to take chances with the adhesive. I've got to put my laminates down with the best. That's why I use Anchor-Weld."

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EASIER TO WORK WITH—brush, trowel or spray it on—practically 100% foolproof!

LONG OPEN TIME—ready in 10 minutes, stays "open" a full six hours!

BONDS INSTANTANEOUSLY...BONDS STRONGER—strength increases with age!

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COSTS LESS PER SQUARE FOOT—higher coverage means Anchor-Weld costs 19% less than closest competitive brand—as much as 45% less than other brands!

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more proof! This young lady finds it easy to make a perfect bond with Anchor-Weld though she has never cemented anything more difficult than putting a stamp on a letter—more proof that Anchor-Weld is just about fool-proof!

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Oct. 1-2. Engineering Institute's Industrial Adhesives Applications Symposium, University of Wisconsin, Madison, Wisc.

Oct. 5-6. Conference on Packaging Specifications, Purdue University, Lafayette, Ind.

Oct. 6-8. National Hardwood Lumber Association, Queen Elizabeth Hotel, Montreal, Canada.

Oct. 6-9. 2nd International Symposium on "High Temperature Technology" sponsored by Stanford Research Institute, Asilomar, Calif.

Oct. 7. Society of Plastics Engineers, Cleveland Section, Cleveland, Ohio.

Oct. 7-9. Sixth National Symposium on Vacuum Technology, American Vacuum Society, Sheraton Hotel, Philadelphia, Penna.

Oct. 10-12. International Congress on Plastics Processing Technology, Amsterdam, Holland.

Oct. 11-16. ASTM 3rd Pacific Area National Meeting, Sheraton-Palace Hotel, San Francisco, Calif.

Oct. 13-14. National Technical Conference, Society of Plastics Engineers, Ambassador Hotel, Los Angeles, Calif.

Oct. 16-25. 13th Packaging and Point-of-Sale Show and 9th Packaging Congress, French Packaging Institute, Paris, France.

Oct. 18-22. The Electrochemical Society, Inc., Deshler-Hilton Hotel, Columbus, Ohio.

Oct. 19-21. National Paint, Varnish & Lacquer Association, Chalfonte-Haddon Hall, Atlantic City, N.J.

Oct. 19-23. 47th National Safety Congress and Exposition, Conrad Hilton Hotel, Chicago, Ill.

Oct. 20. Chemical Institute of Canada, Panel Discussion on the Canadian Chemical Industry, Toronto, Ont., Canada.

Oct. 20-24. 24th Paint Industries' Show, Convention Hall, Atlantic City, N.J.

Oct. 26. National Flexible Packaging Association, The Greenbrier, White Sulphur Springs, West Va.

Nov. 5-6. ASTM, Committee D-14 on Adhesives, Case Institute of Technology, Cleveland, Ohio.

Nov. 12-14. National Association of Lumber Manufacturers, Annual Meeting, Washington, D.C.

Nov. 16-18. 21st Annual National Packaging Forum, Packaging Institute, Statler Hotel, New York, N.Y.

Nov. 16-19. Building Research Institute, Fall Conferences, Shoreham Hotel, Washington, D.C.

Nov. 17-20. Packaging Machinery Manufacturers Institute Show of 1959 and Annual Forum, New York Coliseum and Statler Hotel, New York, N.Y.

Nov. 19. Symposium on Adhesion and Adhesives in Industry, Sponsored by Quantum, Inc., Wallingford, Conn.

Nov. 30-Dec. 4. 27th Exposition of Chemical Industries, New York Coliseum, New York, N.Y.

Jan. 12-15, 1960. 16th Annual Technical Conference, Society of Plastics Engineers, Conrad Hilton Hotel, Chicago, Ill.

Jan. 26-27, 1960. Society of Vacuum Coaters, Technical Conference, New York, N.Y.

Feb. 2-4, 1960. 15th Reinforced Plastics Division Conference, Society of the Plastics Industry, Edgewater Beach Hotel, Chicago, Ill.

William B. Denniston

Named Sales Manager

William B. Denniston has been named general sales manager of Mystik Adhesive Products, Inc., Chicago, Ill. He is a graduate of Brown University and holds a B.S. degree in electrical engineering. From 1941 to 1946, he served in the U.S. Navy as an engineering officer. Mr. Denniston spent two years as general sales manager of Panellit, Inc., and prior to that was with the Shakeproof Division of Illinois Tool Works for six years, in sales management capacities.

New Bonding System

Canadian Industries Ltd. has reported the discovery of what is said to be a cheaper and more efficient system than those now used for bonding polyester fiber to rubber. According to CIL, the discovery resulted from five years of intensive research, and tests in the past few months in cooperation with Canadian rubber companies have confirmed laboratory findings. It is believed that the development may have world-wide implications in the manufacture of tires, industrial V-belts, automobile fan-belts, conveyor belting and other mechanical goods.

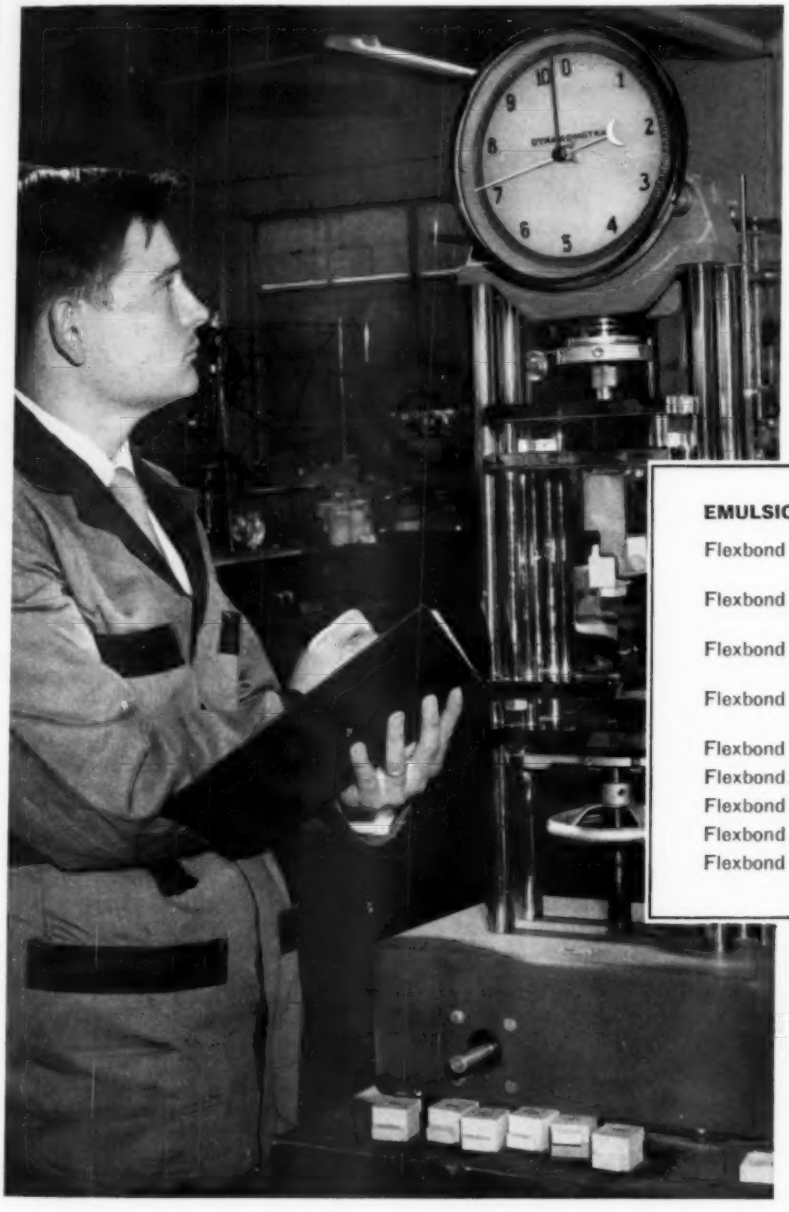
To Build Resin Plant

American-Marietta Co., Seattle, Wash., is planning to build a plant for synthetic resins at Richmond, Calif. Located on the southern fringe of northern California's expanding wood and paper industries, the plant will have an estimated capacity of 28 million pounds a year of urea and phenolic resins. The unit is expected to be on stream in the Spring of 1960.

Developed especially for adhesives

FLEXBOND COPOLYMER EMULSIONS

with improved adhesive properties permanently built into the polymer chain



As adherends increase in variety and complexity the adhesives industry is constantly facing new, special problems. Now Colton offers formulators a welcome problem-solver: Flexbond copolymer emulsions. This versatile group assures better results than conventional emulsions because the units needed for special adhesion are permanently incorporated into the polymer chain. Flexbond copolymer emulsions supply flexible, water-resistant bonds.

With Flexbond copolymers even specialized fields of packaging and film lamination can utilize the advantages of acetate emulsions. And many plastic materials previously considered difficult to join now show enhanced adhesion with copolymer emulsions.

The wide range of grades of Flexbond copolymers now available is suggested by the following table:

EMULSION	DESCRIPTION
Flexbond 800	Vinyl acetate—dibutyl maleate copolymer
Flexbond 803	Vinyl acetate—dibutyl maleate copolymer
Flexbond 802	Vinyl acetate—dibutyl maleate copolymer
Flexbond 855	Vinyl acetate—dibutyl maleate terpolymer
Flexbond 306	Vinyl—acrylic terpolymer
Flexbond 100	Vinyl acetate—stearate copolymer
Flexbond 126	Vinyl acetate—stearate copolymer
Flexbond 128	Vinyl acetate—stearate copolymer
Flexbond 165	Vinyl acetate—stearate copolymer

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AN AIR REDUCTION PRODUCT

Robert W. Howard

Lester R. Dickard

Fasson Products Names Two

Fasson Products, a division of Avery Adhesive Products, Inc., Painesville, Ohio, has named Robert W. Howard as operations manager for Fasson Products, and Lester R. Dickard as research director. Mr. Howard, formerly technical director, is a graduate of Northwestern University. Prior to joining Fasson five years ago, he was associated with Minnesota Mining & Manufacturing Co. Mr. Dickard, previously manager of research and development, is a graduate of Western Reserve University. Mr. Dickard was associated with Grant Photo Products before he became associated with the Fasson Products Division in 1956.

Remoistenable Adhesive

Adhesive Products Corp., New York, N.Y., has announced the development of a clear, water-white, remoistenable adhesive, called Re-Tac. According to the company, when applied to acetate and other plastics, the adhesive will dry transparent and tack free. When moistened with water, an aggressive tack immediately develops, making it possible to adhere the acetate or plastic to glass, metal, wood, paper and other materials, the company states. The adhesive may also be used in the manufacture of adhesive-coated plastic window streamers, which can be adhered to windows and other surfaces merely by moistening with water, the company reports.

Shows Increased Profits

National Starch and Chemical Co. has announced that net income in the six month period to June 30, was $1,550,764, which is equal to 78¢ per common share. Sales in this period totaled $25,934,001. In the first six months of 1958, net income was $1,350,723, or 68¢, and sales amounted to $22,194,635.

Catalin Expands Offices

Catalin Corp. of America, which recently expanded into the fields of nylon molding compounds and acrylic resins, has taken additional office space for the Sales and Advertising Departments at company headquarters, 1 Park Ave., New York, N. Y. In addition, the Accounting and Bookkeeping Departments have been moved from Fords, N. J., and integrated into the firm's New York headquarters to provide greater efficiency and speed of intra-company communications.

3M Fluorochemical Plant

Minnesota Mining and Manufacturing Co., St. Paul, Minn., has announced plans to build a $4,500,000 fluorochemical plant at Decatur, Ala. The facility will also be utilized to produce specialty and modified chemicals for company use. According to Minnesota Mining, the Decatur location was chosen because of its favorable tax climate, its proximity to markets and raw materials, an abundant water supply, good transportation and a good labor market.

Epoxy Production is Greater Than Sales

The Harvard Graduate School of Business Administration has recently released a report called, "Epoxy Resins: Market Survey and Users' Reference", which reached the conclusion that at present epoxy capacity in the United States is about three times greater than sales, however the imbalance will be considerably lessened by 1963. Extensive research and preparation of the report included a survey of about 1,000 companies that manufacture, sell or use epoxies.

The report contains the following significant findings: Sales for coatings manufacture will reach a 48.4 million pound per year rate by 1963, more than double the estimated 21.2 million pounds sold in 1958. Sales to other consuming industries will grow to these levels by 1963—tooling, 6.2 million pounds; electrical, 8.9 million; laminating, 3.9 million; adhesives, 3.7 million; roads, flooring and construction, 12 million; boats, 2 million; and pipes, 3 million.

Total epoxy sales, about 29 million pounds in 1958, are expected to reach 88.1 million pounds in 1963. Although coating uses will continue to be the major outlet, they will account for a smaller percentage of total sales—55 per cent by 1963, compared with 73 per cent in 1958.

The Harvard report covers many other aspects of the epoxy business, citing specific manufacturing applications and details of extensive cost and savings data from companies in each industry.

Earnings Up 69%

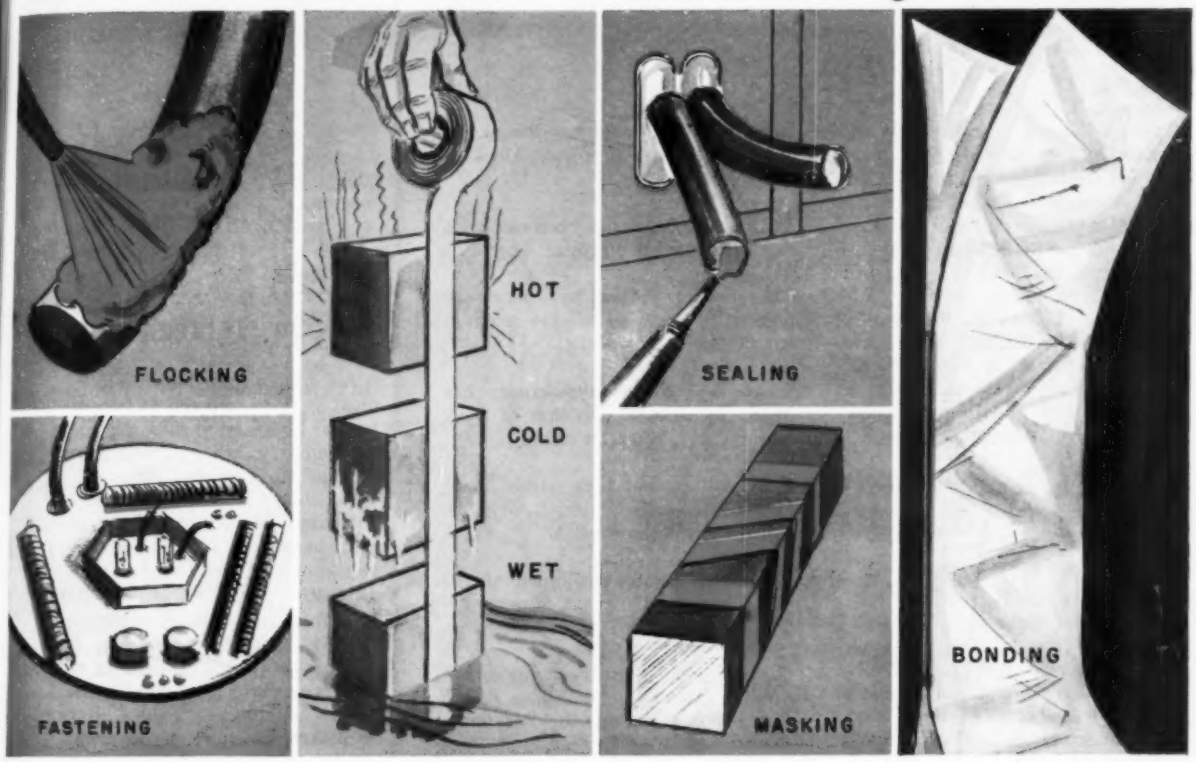
Armstrong Cork Co., Lancaster, Penna., reports that its net earnings in the first half of the year ended June 30 rose 69 per cent to $9,928,000, compared with $5,884,000 for the same period of 1958. The 1959 earnings were equal to $1.91 per share of common stock, compared with $1.12 a share in the like period a year ago. Sales for the first half of 1959 climbed to $142,295,000 from $118,864,000.

Flintkote Names Rippe

Flintkote Co., New York, N.Y. has appointed Melvin W. Rippe district manager for its Flooring and Adhesive Division. Mr. Rippe's territory will cover Oklahoma and the northwest counties of Texas. He will be headquartered in Tulsa, Okla.

SILICONE NEWS from Dow Corning

Wet, Cold, or Hot, They Stick!



Pressure-Sensitive Silicone Adhesives Offer Unusual Properties

Dow Corning *silicone* adhesives have a special set of properties not common to any other materials. These pressure-sensitive silicones form a good bond with practically anything . . . even wet surfaces, polyethylene, or untreated Teflon. They can be applied, and will stay applied, at temperatures from —80 to 500 F. They are highly resistant to moisture, oxidation, corrosive chemicals, weathering, arcing, corona and fungus. They also have excellent dielectric properties.

Put 'Em on Tape. Dow Corning silicone adhesives form superior pressure sensitive tapes with backing materials almost unlimited. Many tapes utilizing these adhesives are already commercially available; they include backings such as glass cloth, Teflon, Mylar, aluminum foil, Silastic®, the Dow Corning silicone rubber, and combinations of these materials. Supplied by several manufacturers, tapes made with Dow Corning silicone adhesives find a variety of end uses, depending on the backing material. Some of these are: electrical insulation in aircraft, ships, power plants, generators and appliances; bonding, splicing, and sealing; masking in chemical milling; release surfacing; electroplating.

They Stand Alone, Too. As independent adhesives with no backing tape, silicone resins perform a multitude of functions . . . many more are yet to be discovered. A few examples of current applications: fastening electronic components together; coating ductwork in aircraft, in combination with asbestos fibers for thermal insulation; sealing the ends of heating elements in appliances; bonding aluminum foil to itself for use in cryogenic systems; bonding mica and asbestos panelboard; bonding Silastic to the coils of electrical equipment; assembling small aircraft parts or components.

Versatile. As tapes, sealants, spray-on coatings, bonding materials, splicing agents, or in other applications, Dow Corning silicone adhesives show good bond and peel strength, and exceptional resistance to deterioration. If you manufacture adhesives, tapes, sealants, or any product making use of these materials, you should investigate Dow Corning silicone adhesives.

Write today for technical data or assistance. Address Dept. 0122.

Your nearest Dow Corning office is the number one source for information and technical service on silicones.

first in silicones

Dow Corning CORPORATION
MIDLAND, MICHIGAN

ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D. C.

names in the news

Harold Sprunger, vice-president and director of Dunbar Furniture Corp., has been elected 1959-1960 president of the National Association of Furniture Manufacturers. He succeeds **Paul Brandt**, who becomes ex officio member of the NAFM board and executive committee. Other NAFM officers are: **Tinsley W. Rucker**, first vice-president; **R. H. McMurtrie**, second vice-president; **Nathan S. Ancell**, third vice-president; **Percy A. Tonk**, treasurer; and **John M. Snow**, executive vice-president.

Dr. David M. Gans has been named vice-president of research for Arco Co., a division of American-Marietta Co.

Walter G. Andrews, formerly vice-president and manager of Resins & Plastics Division of Archer-Daniels-Midland, has been elected executive vice-president of chemical products group. **George K. Nelson** has been named manager of A-D-M's Chemical Products Division.

Dr. Roberts S. Braman, formerly with Callery Chemical, has joined Armour Research Foundation as a research chemist while **John S. Shanly**, previously with Houghton Laboratories, has joined the Plastics and Rubber Technology Section of the Foundation.

David R. Riggs has resigned as vice-president of the Eastern Container Division of Container Corp. of America.

M. M. Gruber, formerly head of coatings resins sales for Ciba Products Corp., has been promoted to sales manager; **Elliott N. Dorman**, formerly head of structural resins sales has been appointed technical sales manager; and **Richard H. Malamphy**, previously with Swedlow (Plastics) Inc., joins Ciba as manager for new products.

H. B. Morley, formerly supervisor of inorganic research at Wyandotte Chemicals, has been appointed manager of the Inorganic Research Department.

Robert S. Klonowski has joined the Solvent Adhesives Research Division of Swift & Co.

William F. Drees has been elected a vice-president of Formica Corp.

Robert E. Levitan has been appointed manager of market research for Berkshire Chemicals.

Lawrence B. Kohlenberger has joined the Silastic Division of Dow Corning as a research chemist.

E. K. Stilbert has been named manager of coatings materials of Dow Chemical Internation, Ltd.

Donald H. Hunter has joined American Chemical Corp. as a polyvinyl Chloride chemist.

G. J. Klusmire has been appointed product manager for Saran Wrap and Trycite films for the Packaging Division of Dobeckmun Co.

E. S. Harrar, dean of the Duke University School of Forestry, has succeeded **W. Peter Eason** as president of the Forest Products Research Society.

Arthur C. Dreshfield has joined the Chemicals-Pigments-Metals Division of Glidden Co. as director of paper research and development.

Dr. Laszlo Auer has left Geigy Chemicals to reactivate his consulting practice specializing in textiles, protective coatings, synthetic resins and elastomers at New Rochelle, N. Y.

Lillian Roth, formerly with Callery Chemical, is now technical bibliographer in the editorial office of the Institute of Paper Chemistry.

Paul W. Atwood, president of U B S Chemical, has been named to the board of directors of A. E. Staley Mfg. Co. **Dr. Leonard F. Barrington** has been appointed director of applications research for A. E. Staley, succeeding **James P. Casey**, who has joined Union Starch & Refining Co.

Jacob J. Bikerman

Portrait of

JACOB J. BIKERMAN

A frequent contributor to technical journals and the author of several books on various aspects of chemistry, Jacob J. Bikerman is supervisor of the Adhesives Laboratory of the Massachusetts Institute of Technology. He was born in Odessa, Ukraine, and is a graduate of the University of Petrograd.

Before coming to this country in 1945, Mr. Bikerman held a number of academic positions in Western Europe, including research assignments at the Kaiser Wilhelm Institute of Physical Chemistry, the University of Manchester and the University of Cambridge. He first became interested in the science of adhesion while he was research director of Glass Fibres Ltd., Glasgow, Scotland. The usual theory of molecular adhesion did not appear convincing to him, and his lack of confidence in this theory was intensified under the broadening influence of his experience and activity as leader of the Adhesives Group of the Printing and Allied Trades Research Association, London, England.

Earlier this year, Mr. Bikerman was represented in the pages of ADHESIVES AGE with a feature article on "Making Polyethylene Adhesionable."

At the recent Atlantic City convention of the American Chemical Society, Mr. Bikerman was one of the featured speakers at the session of the Colloid Chemistry Division. His topic, of course, was adhesion, specifically, the "Physicochemical Aspects of Adhesive Joints."

Plans New Laboratory

Formica Corp., Cincinnati, Ohio, a subsidiary of American Cyanamid Co., is starting construction of a new research and product development laboratory at its Evendale, Ohio, manufacturing plant. Scheduled for completion by Spring, 1960, the new facility will substantially increase Formica's research and development activity and will consolidate all product development and application work under one roof. Formica's basic research, however, will continue to be carried out at Cyanamid's Central Research Division laboratory in Stamford, Conn.

The new unit, a 30,000 square foot, one-story building, will be located alongside the company's 550,000 square foot manufacturing plant on Reading Road in Evendale. The laboratory will have an enlarged staff of engineering and technical personnel concerned with research and engineering, product application, process engineering and new product development.

Named Manager

Donald G. Patterson has been named manager of the recently formed Plastics Division of Reichhold Chemicals, Inc., White Plains, N.Y. With the exception of phenolics, Mr. Patterson will be responsible for all company activities in the plastics area, including resins for adhesives, laminating, casting and molding. Mr. Patterson will also act as technical coordinator for the recently acquired Specialty Chemicals Division. The company also has announced that William A. Turner has been appointed sales manager and Charles S. Stryker technical service manager for its Polyester and Epoxy Resins Department.

New French Company

A new company, Progil-Bayer-Ugine, is being formed in Paris, France, to produce and sell isocyanates, polyesters and polyethers. According to reports, the company is planning to construct a plant at Grenoble, France, and some of the output will be exported. The parent companies of the new firm are: Farbenfabriken Bayer AG, Leverkusen, Germany; Societe d'Electrochemie, d'Electrometallurgie et des Acieries Electriques d'Ugine, Paris, France; and Progil S.A., Paris, France. The Bayer concern will provide 50 per cent of the share capital, it is reported.

No. 3 of a Series

GRIPPING STORIES

from the files of Angier Adhesives

The Case of the BAFFLED DESIGNER

It was a tough job and "Rush", but now he had it licked. All he needed was the adhesive that would join the rubber component to the metal base. "No problem here," he thought, as he specified the rubber-to-metal formula that had been so successful in a previous job.

But there *was* a problem and it became more and more apparent as one after another of the trial bondings failed.

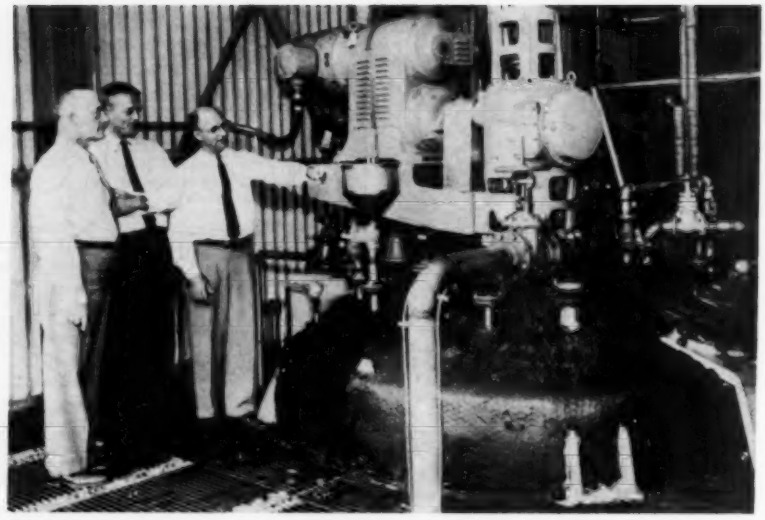
Once on the case, an Angier man unravelled the mystery in short order. He pointed out slight—*but important*—differences between the old product and the new—in rubber compound used, in end-product vibration and in heat and stress factors involved. He recommended an adhesive that was perfect in every respect and the designer met his deadline with two days to spare.

Turn to Angier *first* for job-tailored adhesives that are developed, tested and produced *by experts* to give you the most efficient product for every job at the lowest price per end-product unit.

Call or write today *for complete information.*

ANGIER ADHESIVES

INTERCHEMICAL CORPORATION
Finishes Division
120 Potter St., Cambridge 42, Mass.
Midwestern Plant: HUNTINGTON, IND.



Dr. Stefan H. Baum, RCI executive vice-president; John G. Penniman, manager of the Emulsion Division; and F. Albert Smiles, vice-president at the Elizabeth plant inspect the newly installed emulsion kettle at Reichhold's Elizabeth, N. J., plant.

Reichhold Installs Emulsion Kettle

Reichhold Chemicals Inc. has installed a new $265,000 emulsion kettle at its Elizibeth, N. J. plant. Depending on product mix, the new unit is said to be able to produce up to 30,000,000 pounds of vinyl acetate homopolymer and copolymer emulsions and a full line of acrylic emulsions annually. Maor uses for these products are protective and decorative coatings, adhesives, floor polish, and leather, textile and paper finishes. The new kettle is believed to be the world's most modern, incorporating several unique design features which permit an optimum balance of properties for the different types of emulsion users.

Named Vice-President

Dr. William B. Reynolds has been named vice-president and director of research of General Mills, Inc., Minneapolis, Minn. Dr. Reynolds will be responsible for the coordination of research conducted by the firm's Central Research Laboratories as well as by its divisions, and for the integration of such work in the total research program of General Mills. Dr. Reynolds is a graduate of Cornell College, and holds a Ph.D. in organic chemistry from the University of Chicago. After service with DuPont and Interchemical Corp., he served as a research instructor at the University of Chicago. In 1943, he went to the University of Cincinnati as assistant professor and later became associate professor and head of the Chemical Division of the university's Applied Science Department. Since 1946, Dr. Reynolds has been associated with the Phillips Petroleum Co., where he first supervised its synthetic rubber program.

Assumes New Duties

Container Corp. of America, Chicago, Ill., has announced that Harry E. Miles, vice-president, will be responsible for all the company's corrugated shipping container plants with the exception of West Coast properties. Mr. Miles will also continue to be responsible for national coordination of sales policies in the Container Division. He was formerly general manager of the company's Mengel Corrugated Box Division, and was elected vice-president of Container Corp. in 1958. He will continue to make his headquarters in Louisville, Ky.

Expands Facilities

B. B. Chemical Co., a subsidiary of United Shoe Machinery Corp., has announced that it has expanded its service laboratory facilities at Cambridge, Mass. The company reports that the expanded facilities will be used for adhesives studies and testing.

TAPPI Conference Held in Oregon

The Technical Association of the Pulp & Paper Industry held its Tenth Annual Testing Conference on August 17-21 at the Multnomah Hotel in Portland, Ore. The meeting, attended by several hundred American and foreign technical experts, featured 18 outstanding speakers who presented a variety of technical papers. The conference had as its primary aim the development and issuance of standards for the pulp and paper industry, which includes every step of paper making and uses from forestry to printing.

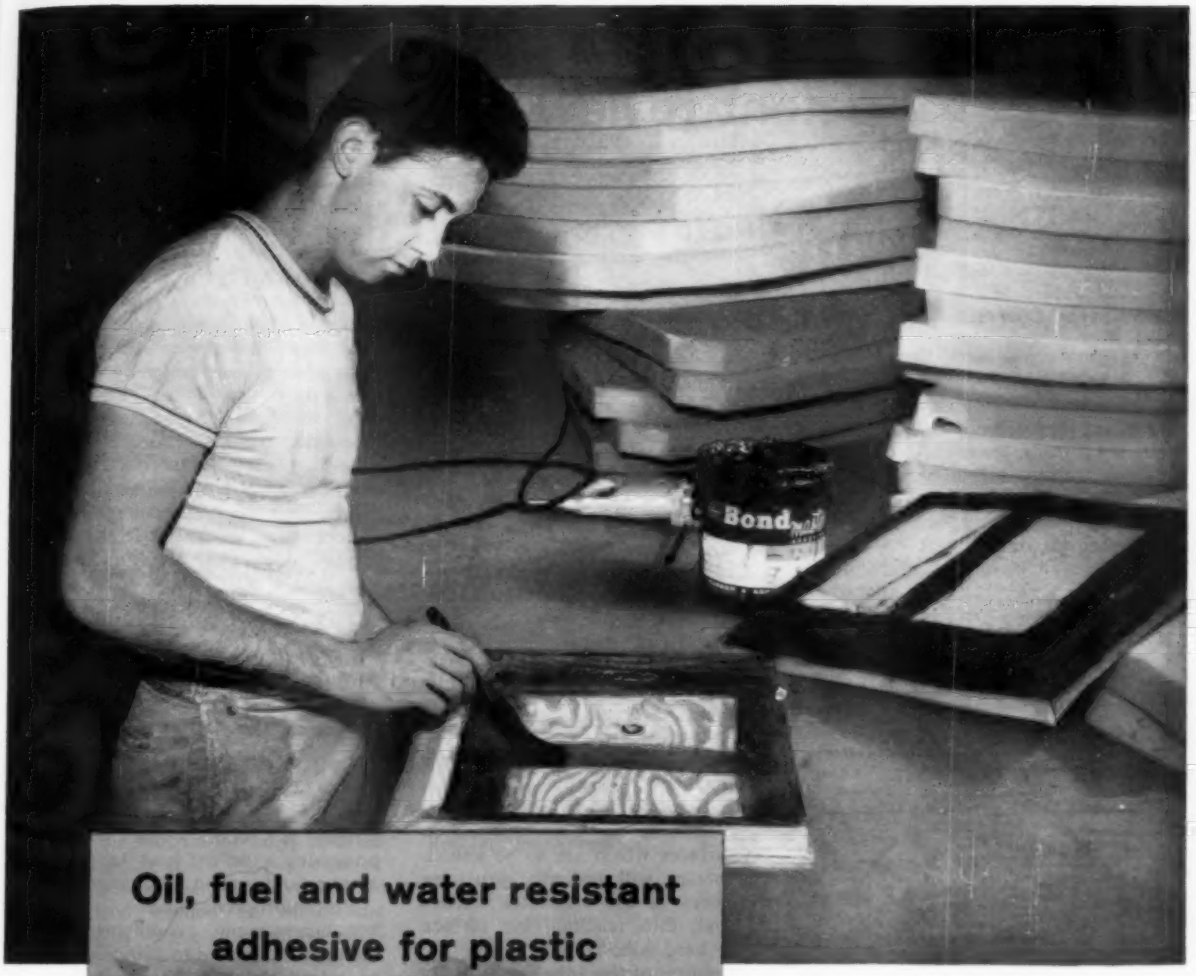
Tappi also announced that its Eleventh Annual Testing Conference will be held on September 27-29, 1960 at the Pantlind Hotel, Grand Rapids, Mich. Technical sessions already planned for this conference are Adhesive Testing; Water Testing; and Relative Humidity and Paper Testing, co-sponsored with ASTM Committee D-6. Anyone wishing to offer a paper for the Eleventh Testing Conference should contact W. H. Aiken, Diamond-Gardner Corp., Middletown, Ohio.

Opens Midwest Office

Rubber & Asbestos Corp., Bloomfield, N.J., has announced the opening of a Midwest area sales office at 3553 West Peterson Avenue, Chicago, Ill. According to the company, the establishment of a centralized contact point effectively shortens the lines of communication so as to assure swifter technical service to production users of adhesives in this highly industrialized section of the country. The company also announced that Stewart Marshall has been transferred from the New Jersey office to the new Midwest location to insure uninterrupted liaison with those who formerly dealt directly with the company's Eastern facilities.

Elected President

International Epoxy Corp., Fort Lauderdale, Fla., has announced the election of Dr. Raymond E. Robinson as company president. Dr. Robinson previously held the post of executive vice-president. Prior to joining International Epoxy, Dr. Robinson was the founder, owner and president of Robinson Industrial Craft of London, Ontario, Canada. The company also announced tentative plans to open a Canadian branch plant.



Oil, fuel and water resistant adhesive for plastic foam made with

RCI PHENOLIC RESIN

• The Rubber and Asbestos Corporation of Bloomfield, N. J., uses a Reichhold phenolic resin as an important ingredient in the manufacture of their Bondmaster® G472 liquid adhesive.

Bondmaster G472 is a general purpose adhesive designed for bonding vinyl plastics, nitrile rubbers and cotton duck to metal, wood, concrete and other rigid surfaces.

In one application, illustrated above, the Bondmaster formulation was required to make a strong, sure bond between plastic foam and a wooden chair frame that had to withstand the rigors of marine usage. Bondmaster G472 fitted the job perfectly.

In a recent interview, an R & A formulating chemist said, "The high order of specific adhesion to the plastic foam—which makes Bondmaster the right adhesive for this job—is a direct result of the Reichhold phenolic resin."

Reichhold offers a line of phenolics especially developed for adhesive formulators. And if you're compounding adhesives, remember that RCI is also a major producer of both epoxy resins and PVAc emulsions.

Creative Chemistry . . . Your Partner in Progress

REICHHOLD RCI

REICHHOLD CHEMICALS, INC., RCI BUILDING, WHITE PLAINS, N. Y.

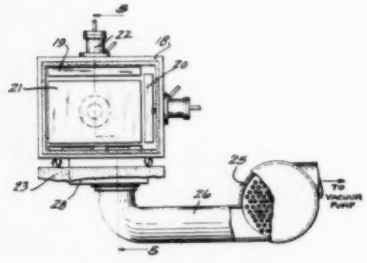
Synthetic Resins • Chemical Colors • Industrial Adhesives • Phenol • Hydrochloric Acid • Formaldehyde • Glycerine • Phthalic Anhydride
Maleic Anhydride • Pentachlorophenol • Sodium Pentachlorophenate • Sulfuric Acid • Methanol
Sebacic Acid • Ortho-Phenylphenol • Sodium Sulfite • Pentaerythritol

By MELVIN NORD

Cementing Cartons

U.S. Patent 2,885,840, issued May 12, 1959 to Glen G. Blackburn and assigned to the Berst Corp., provides a method for internally sealing or cementing cartons, boxes and laminated materials, using a thermoplastic cement.

The thermoplastic adhesive can be applied to the desired surfaces when the carton blank is cut or at any subsequent time. Since the adhesive selected is one which is solid and non-sticky at ordinary atmospheric temperatures, it does not interfere



with the subsequent handling of the blank or the filling of the carton. The adhesive becomes non-adhesive as soon as it cools. The adhesive used in practice is one which does not soften below the approximate temperature of 160°F.

Thermoplastic adhesives that have been used successfully are Proxmelt #12-291-1, a product of Pyroxylin Products, Inc. of Chicago, Illinois; and Vinylite Resin X-1 5075, a product of Union Carbon and Chemical Co.

After the cartons are filled and closed by overlapping their flaps in the usual manner, or after the veneer or plies of wood which have previously been coated have been stacked in the order desired for lamination, in either case, the pieces of work are placed in a treating chamber such as that shown (18) in the schematic. Within this chamber are provided as many pressure plates (19, 20 and 21) as may be required to subject to pressure the surfaces which are to be joined adhesively. For most purposes, a single pressure plate (19) at the top of the chamber will suffice.

The door (23) is now tightly closed and the chamber (18) is evacuated. The vacuum pump as such is not shown but a condenser (25) is shown, through which gases withdrawn from the chamber (18) are passed enroute to the pump. The degree of vacuum is such as to remove the air of the chamber completely and to withdraw substantially all air from the fibrous material which is to be adhesively joined.

When the air removal is practically complete, the vacuum connection is closed and the vacuum is relieved by admitting water vapor or steam at the requisite temperature to the chamber. The steam or water vapor will, of course, be supplied at a temperature sufficient to soften whatever adhesive has been applied to the surfaces which are to be joined. The steam will instantly penetrate the pores of the evacuated fibrous material, thus reaching the surface of the hard adhesive and raising the temperature of the adhesive virtually instantaneously to its melting point.

Sealable Adhesive Composition

U.S. Patent 2,886,248, issued May 12, 1959, to James J. Landig, assigned to the Texas Co., related to an adhesive sealing composition particularly suitable for railroad tie pads.

The basic composition comprises 45-65 weight per cent asphalt having a penetration of between 30 and 50 and a softening point of between 100°F. and 170°F., 5-25 weight per cent heavy naphthene base residuum of viscosity about 40-55 Saybolt Furol seconds at 210°F., 3-12 weight per cent pine tar, and 10-35 weight per cent of at least one rubbery elastomer.

As shown in the schematic diagram, a strip of roofing felt (9) is passed through feed rolls (10) and saturated with the adhesive composition (12), maintained as a soft plastic or molten mixture with heat and agitation in a tank (11). The saturated felt (13) is passed through rolls (14) adjusted to control the thickness of the pad piece at the desired gage. The strip is then passed through a cooling zone (15) where the temperature of the strip is reduced to about 100°F. or less. Slip sheet ribbons (16 and 17), comprised of glassine or other paper having a non-sticking silicone treated surface, are applied to the top and bottom faces of the strip by rolls (18). Tedders (19) feed the covered strip into a cutter (20) wherein the strip is severed into covered tie pads (21). These tie pads descend a chute (22) and are sent to a bundling machine, which is not shown.

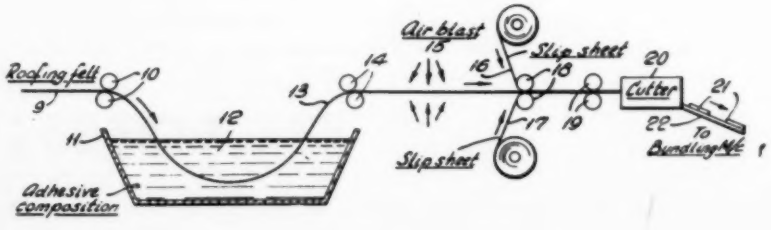
Rubber Base Adhesive

U.S. Patent 2,884,400, issued April 28, 1959 to Clarence D. Moore assigned to Armstrong Cork Co., describes a rubber base adhesive possessing excellent heat fatigue resistance and a good tack range.

Polychloroprene and a rubbery butadiene-styrene copolymer are blended and heated to 230°F.-325°F. to selectively cure the polychloroprene without curing the copolymer. The resulting product is then dispersed in a solvent for the selectively cured blend.

Paper Label Adhesive

U.S. Patent 2,884,396, issued April 28, 1959 to Anthony J. Allegretti, assigned to R. R. Donnelley & Sons Co., describes an adhesive composition for applying paper labels to hard inked surfaces such as are encountered in high quality magazine. The adhesive consists of 1-5 parts of bentonite, 72-220 parts of water and 22-44 parts of polyvinyl methyl ether.

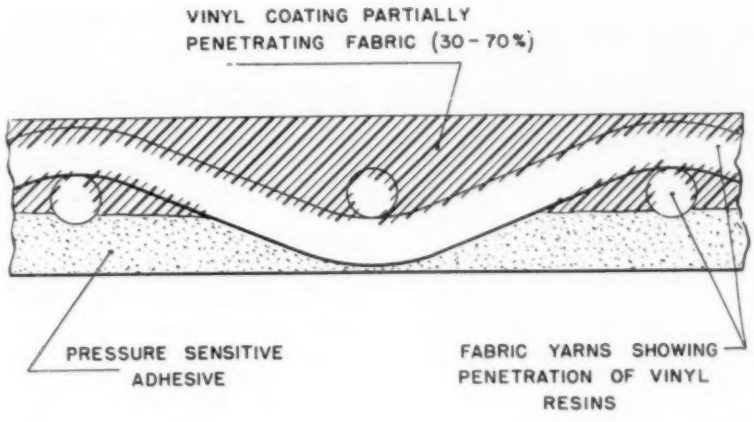


Adhesive Sheet Material

U.S. Patent 2,887,403, issued May 19, 1959 to Ernst A. Wolff and assigned to the Kendall Co., relates to pressure-sensitive adhesive tapes having superior stability under ordinary and unusual conditions of storage and use and, in addition, improved water repellancy, appearance and color.

The object of the invention is to provide adhesive tape with a coating which is sufficiently adherent to the backing to prevent its being stripped from the fabric by the adhesive mass on unwinding the material from the roll or core on which it is usually wound.

As shown in the diagram, the tape of the present invention is of the type having a fabric backing provided on one side with a layer of suitable adhesive material, and on the other side a resinous coating which provides a protective and decorative outer surface when the tape is used in the customary manner. The resin coating is applied to the backing in the form of resin latices, including specifically one or a mixture of such latices as the latices of polyvinyl chloride, coplomers of vinyl chloride and vinyl acetate in which the amount of vinyl chloride in the polymer is 88 per cent or greater, copolymers of vinyl chloride and vinyl acetate in which the amount of vinyl chloride in the polymer is 88 per cent or greater, copolymers of vinyl chloride and vinylidene chloride, copolymers of vinyl chloride and ethyl acrylate or octyl acrylate, coploymers of vinyl chloride and acrylonitrile, and a polymer latex resulting from the polymerization of vinyl chloride in an emulsion system in the presence of a butadiene-acrylonitrile copolymer.


VINYL COATING PARTIALLY PENETRATING FABRIC (30-70%)
PRESSURE SENSITIVE ADHESIVE
FABRIC YARNS SHOWING PENETRATION OF VINYL RESINS

Improving Starch

U.S. Patent 2,884,347, issued April 28, 1959 to Kenneth C. Hobbs, assigned to Corn Products Co., describes a process for improving the color and clarity of pastes made from "thin boiling" starch or hydroxylalkyl starch in granule form.

The starch is filtered and washed at a pH of 2.0-3.0. It is then reslurried, adjusted to a pH of 6.0-8.0, and then filtered, washed and dried. It is believed that the acid liberates traces of compounds of calcium, magnesium and iron which tend to form complexes with carbohydrate materials.

Other Patents of Interest

Subject	Inventor or Ass'gnee	Patent No.	Date
Polystyrene container with label adhered to it	Armstrong Cork Co.	2,880,898	4/7/59
Manufacture of adhesives for corrugated paper	Chas. A. Krause Milling Co.	2,881,086	4/7/59
Heat resistant pressure sensitive adhesive tapes	American Tape Co.	2,881,096	4/7/59
Manufacture of bone glue	Armour & Co.	2,881,158	4/7/59
Roll type glue spreaders	Robert S. Black and James S. Carroll	2,881,731	4/14/59
Method of spreading a pressure-sensitive thermoplastic adhesive	Johnson & Johnson	2,882,179	4/14/59
Adhesive tape for anti-corrosive cold use	Jacques J. Trachet	2,882,184	4/14/59
Paste pointing synthetic resin composition	Pittsburgh Plate Glass Co.	2,882,252	4/14/59
Adhesive label dispenser	Lawrence W. Kendrick	2,883,044	4/21/59
Production of cereal starch	Kurt Bernheim	2,883,309	4/21/59
Pressure-sensitive adhesive sheet material	Minnesota Mining & Mfg. Co.	2,884,126	4/28/59
Binder for foundry sand molds	Michael B. Karr and William V. Karr	2,884,333	4/28/59
Cement for stabilizing soil	E. I. du Pont de Nemours & Co., Inc.	2,884,334	4/28/59
Gum accroides adhesive composition	The Borden Co.	2,884,335	4/28/59
Pressure-sensitive adhesive sheet material	The Kendall Co.	2,884,342	4/28/59
Preparation of paperboard adhesives	Koppers Co., Inc.	2,884,389	4/28/59

Copies of any patents, including those described here, are available from the Commissioner of Patents, Washington 25, D. C., for 25 cents each. Do not send stamps.

new equipment

Carton Force Tester

The instrument is designed to help carton manufacturers control production quality and eliminate rejects, and to enable users of automatic cartoning machines to specify cartons to a recognized standard and discover "tough" cartons before they can cause filling line slowdowns and stop-

pages. The tester, called Scorebend Tester, measures the force required to "break-open" flat folded paperboard cartons. It enables one-man production testing with laboratory instrument precision. To perform the carton test, a flat carton is inserted on edge between a grooved base and the notched compression of the gage. The inspector then turns a knob to depress the gage and force the carton open. The indicator hand holds the maximum dial reading to show the actual opening force exerted. Three models of the Scorebend Tester are available: Model CC-500, for forces ranging from 0 to 500 grams; Model CC-100, for forces ranging from 0 to 100 grams; and Model CCO-1, for forces ranging from 0 to 16 ounces. The only difference between models is the force gage with which it is equipped and all three gages are interchangeable on the standard test stand and mount. Each gage has an accuracy of better than 1 per cent of full scale, and dial indicator hands can be made free-moving or set to hold the maximum reading by a control button. *Hunter Spring Co.* **E-121**

Electric Heating Elements

ThinStrip electric heating elements are designed for rapid heat transmission. The elements offer the lowest barrier or heat lag from energy applied, except for an exposed resistor itself, which results in faster transmission of heat to the container or substance with less loss through radiation. The average ThinStrip is ⅛ inch to 5/32 inch thick over the heating surfaces, depending upon the thickness of resistors, insulation and sheath required. The units are available in standard 115 or 230 volts, and are also available for 6, 12, 24 and 57 volts, consistent with the practicability of fabricating the heavier resistors required. ThinStrip units can be used as heaters in mounting presses, panel heating, instrument heating, sealing bars, forced air heating, platen heating and package sealing. *Acra Electric Corp.* **E-122**

D.C. Motor

Called Model D-1000, this 1.6 hp, 28 volt D.C. motor is suited for applications requiring a rugged lightweight power unit in aircraft, missile, ordnance, marine and industrial installation. The normal operating range is .6 hp to 1.8 hp at 2,000 rpm. It has an integral cooling fan and an explosion proof construction according to MIL-E-5272A. The brushes are easily accessible, and the motor operates continuously at 260°F. at 60,000 feet altitude. *Hoover Electric Co.* **E-123**

Hotplate Shaker

A new rotating tilting hotplate-shaker, called Roto-Tilt, is designed for rapid evaporation of liquids, speedy dissolving of solids, or general purpose shaking. The instrument imparts a swirling motion to liquids similar to that produced manually, and it holds various size and shape containers. The amount of heat and speed of agitation are controllable. The machine can be used as a shaker only, without the hotplate. *Eberbach Corp.* **E-124**

Hand Spray Gun

The P-MBC hand spray gun is adaptable to all types of manual spraying and production requirements. It is equipped with a removable spray head and can be used with almost any material that is

sprayable and for many highly specialized applications. The manufacturer claims that the ball and cone principle of its nozzle parts alignment assures perfect metal to metal seal and perfect centering. It has a full size, two finger trigger which is reinforced at wear points with hardened steel. The body is made of forged aluminum and the net weight is 1 pound, 10 ounces. *DeVilbiss Co.* **E-125**

Electric Label Dispenser

An electric dispenser of pressure sensitive labels, designated Model E-350, has a dual purpose foot switch which permits either continuous or intermittent label dispensing. A rheostat speed control can be set to

the desired dispensing speed. The dispenser has an operating speed of 10 to 150 inches per minute and a capacity of 3/16 inch to 3 inch wide rolls. It is constructed of cast aluminum and has self lubricating bearings. Weight of the unit is 17 pounds, and dimensions are 13¾ x 7⅛ x 6⅝ inches. *Avery Adhesive Label Corp.* **E-126**

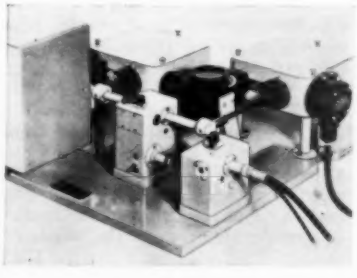
Agitation Jar

Called M Magni-Whirl Jar Baths, the unique method of agitation of these baths maintains constant uniformity by gentle and automatic pulsation of the Magni-Whirl agitator plate. The clear jar permits full visibility, and the constancy of

uniformity is ±0.10°C. The packaged control compartment located at the top of the bath is easily removable as a complete unit to permit cleaning. Temperature ranges of the Pyrex jar are ambient to 70°C or 100°C. The Dual Microtol control allows automatic selection and repetition of the two most used temperatures or serves as an excess temperature cut-off. *Blue M. Electric Co.* **E-127**

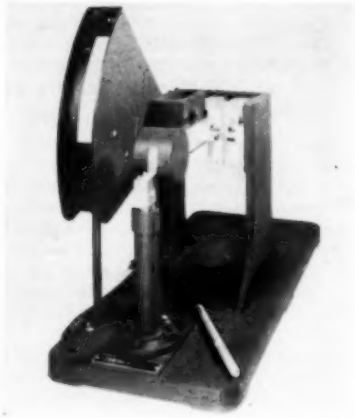
Spectrofluorometer

The unit is a triple-purpose instrument which can be utilized as a spectrofluorometer, spectrophotometer or for reflectance measurements of solid samples such as plastics, powders, paints, paper, textiles, etc. The instrument has been designed so that chemical constituents under investigation can be irradiated in any chosen wavelength of the ultraviolet visible (or infrared regions) through an excitation monochromater and the measurement of the resulting fluorescence likewise obtained at any chosen wavelength in these regions through an analyzing monochromater. The system of the instrument is arranged so that special curves can be established for the selection of the optimum wavelength for a constituent as well as for identification or quantitative assay of various compounds. It also can be used for micro or macro techniques and is particularly suited for measurements of extremely low concentrations. *Farrand Optical Co., Inc.* **E-128**



Torsion Tear Tester

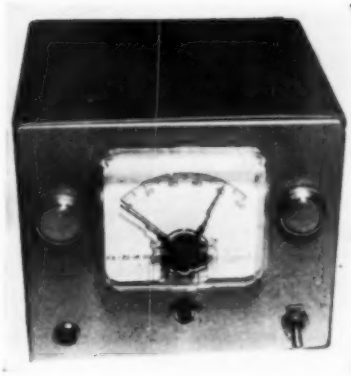
This heavy duty torsion tear tester measures the tearing strength of strongly directional materials which tend to tear at an angle from the application of force. The tester holds the specimen rigidly throughout its entire length on both sides, and the



tearing force is directed to produce a tear down the center line of the specimen. The company recommends its use in measuring the tear strength of cylinder board, corrugated board, glass fiber reinforced gummed shipping tape, vinyl and rubber sheeting, gauze and other woven fabrics. *Thwing-Albert Instrument Co.* **E-129**

Skip Meter

This photometric instrument was designed for detecting skip on paperboard. The exposure head consists of a light source, sensing photocell, microammeter, relays and control switches. The exposure head, approximately 6 x 6 x 3 inches, is mounted directly over the moving web of paperboard. It is capable of providing continuous monitoring on the production line. By means of relays, the



skip meter, approximately 7 x 7 x 6 inches, will automatically ring a bell, light a lamp, mark the surface, or stop the machinery whenever preestablished tolerance limits are exceeded. According to the manufacturer, the skip meter can be modified slightly, as needed, to provide continuous quality control on a number of other products similar to a moving web of paperboard or on a conveyor belt. It is useful in controlling color, color brightness, gloss, haze and turbidity. *Gardner Laboratory Inc.* **E-130**

Thickness Gauge

This Gauge is a small, compact instrument for measuring the thickness of paper, blotting paper, crepe paper, carbon paper, paperboard, boxboard, rubber, plastics, tin, sheet brass or steel, mica, felt, cloth and other resilient materials. The dial is 2 inches in diameter and is graduated in

thousandths of an inch with half thousandths sub-sidivisions. With this gauge it is possible to tell material thickness instantly, and also to approximate the basis weight of paper. In operation, a button is pressed and the thickness is registered on the dial. Gauges are available with metric dial graduated from 0 to 2.8 millimeters in hundredths millimeter subdivisions. *Minden Paper Gauge Co.* **E-131**

book reviews

Glossary for the Protective Coatings and Plastics Industry (Revised—Fourth Edition). *By L. J. Radi. Published by Color & Chemicals Division, Interchemical Corp., Hawthorne, N.J. 4¼ x 7 in. 158 pp. $2.00.*

The *Glossary* first appeared in print in 1944 as a four-page supplement to the R-B-H Dispersions monthly booklet. In the last 15 years, with the broadening of the industry and the growth of plastics and resin technology, the subject of the *Glossary* has become ever large and complex. The previous revisions have tried to keep up with this growth, and this Fourth Edition has endeavored to encompass the latest developments.

The *Glossary* is written for those who are not familiar with technical language. Naturally, as with all specialized vocabularies, it is unavoidable that some technical words and phrases must be defined in terms of other technical words. However, the author has tried to eliminate such circular definitions as often as possible. For the most part, the author has tried to follow a fourfold rule whereby the definitions would be (1) accurate, (2) brief, (3) clear, and (4) in non-technical language.

The *Glossary* lists only those terms which will occur most frequently in technological, sales and semi-technological discussions. It was not possible to list every protective coating and plastics term and still keep the *Glossary* a pocket guide book, a role it has played so well.

In this edition, the author found it convenient to bring together in two appendices all definitions pertaining to polymers and mechanical behavior. Formerly scattered throughout the pages of the *Glossary*, these definitions may now be seen in perspective with each other and with the broad subjects of which they are a part.

An Introduction to Chemical Engineering. *By Charles E. Littlejohn and George F. Meenaghan. Published by Reinhold Publishing Corp., 430 Park Ave., New York 22, N.Y. 6 x 9¼ in. 271 pp. $7.80.*

This book is intended primarily as a beginning text for students in chemical engineering and related professions. It presents material that must be mastered before a study of unit operations and thermodynamics is begun. It does not contain chemical engineering theory *per se*, but rather is devoted to explaining some of the fundamentals upon which that theory is based.

Subjects which the authors have chosen to explore include the profession of chemical engineering; sources of information in chemical engineering; graphs and graph paper; fundamental dimensions and conversion of units; process variables; molecular units; compositions of mixtures and solutions; PVT relations for gases; mixtures of vapors and gases; material balances; energy balances; equilibria in chemical systems; combined material and energy balances; dimensional analysis, and economic considerations. A number of valuable appendices are included.

Source Book of Industrial Solvents. Volume 3. Monohydric Alcohols. *By Ibert Mellan. Published by Reinhold Publishing Corp., 430 Park Ave., New York 22, N.Y. 6 x 9¼ in. 276 pp. $10.00.*

The third in a series, this volume presents the physical properties, azeotropic mixtures and uses of industrial alcohols. The nomenclature includes commercial names where applicable. A historical survey describes the early production by malting and brewing and leads up to present day synthesis—Fischer-Tropsch, Isosynthesis, Oxo Process and the Oxyl Process.

Methods of manufacture and newer methods of fermentation are also discussed. The book includes many significant tables and figures. Because alcohol solvents enter into every kind of industrial activity, this handy reference fills an urgent need for a convenient source of information on these substances.

Phenolic Resins. *By David F. Gould. Published by Reinhold Publishing Corp., 430 Park Ave., New York 22, N.Y. 5 x 7½ in. 213 pp. $5.75.*

Here is a concise presentation of the raw materials, production methods, and applications of the phenolic resins. The book emphasizes the practical features, including commercial and economic considerations. It describes each major field of application in a separate chapter, and is up-to-date in every respect. Numerous disclosures in patents and elsewhere serve as a basis for the development of new uses for the phenolics. There is also information on the use of phenolics in combinations with other resins.

Chapter Five is devoted to adhesives, and the author discusses adhesive production, durability, varieties, resins used, problems, curing, phenolic-epoxy blends, phenolic-vinyl blends, phenolic-rubber blends, adhesives containing neoprene rubber and polyamides. Also discussed are such adhesive applications as metal bonding, glass bonding, plastics bonding, rubber bonding, wood bonding and miscellaneous bonding.

The subjects of the other chapters are: Present Status of Phenolic Resins; Raw Materials; Resin Production; Molding Compounds; Laminates; Wood Products; Bonding and Impregnating Agents; Coatings; Castings, Foams and Spheres; Rubber Compounding; Applications not Otherwise Classified; and Prospect. Following each chapter is a reference bibliography.

Engineers, designers, architects and management have in this book a complete picture of present and potential uses of phenolic resins.

Trade Literature

Adhesives for Railroads. This eight page, two color, 8½ x 11 inch illustrated catalog describes adhesives, coatings and sealers for the railroad industry. Twenty-three typical applications of 11 different types of the company's adhesives, coatings and sealers used on a typical piece of rolling stock are listed in the catalog. Two pages are devoted to photographs showing application methods for various materials to prevent corrosion; seal out water, air and dirt; mount floor coverings; adhere insulation; and resist abrasion. *Minnesota Mining & Manufacturing Co.* **L-129**

Industrial Coatings. Clear and colored coatings for use on metal, plastics, glass and wood are discussed in this 36 page brochure. Information on numerous coatings for application to the various surfaces by spraying, screening or roller coating is provided. Data is given on standard colors available including metallics, bronzeless gold and other special effects. Information relating to the application of coatings of special interest to those who use or specify coatings is also included. *Bee Chemical Co.* **L-130**

Sharpening Knives. This wall chart, 11 x 15 inches, describes and illustrates the correct methods for sharpening paper and veneer cutting knives. The step-by-step procedures for both grinding and honing are discussed in chart form. Also included are recommended cutting angles for paper stocks, rubber, veneer and many other materials. On the back of the chart is a handy knife check list to aid in compiling inventory and specification data on knives and cutting equipment. *Simonds Worden White Co.* **L-131**

Time and Event Recorders. This four-page brochure details a wide range of the company's alpha-numeric printers and digital read-out systems capable of handling the outputs of high-speed reduction from the simplest to the most complex system data. Tables show the unusually large numbers of standard combinations possible using standard counters and time units. The brochure lists a broad variety of speeds, types of inputs, outputs, and time indications to choose from. Custom requirements are also covered. Incorporated in the new brochure is an unusual guide for specifying individual data printer requirements. *American Electronics, Inc.* L-132

Electrical Heating Units. The Chromalox line of electrical heating units and equipment for industry is presented in detail in a 64-page booklet. Complete technical information and photographs and schematic diagrams are utilized. Sections of the booklet are on application information, strip elements, ring elements, tubular elements, cartridge elements, immersion heaters, circulation heaters, air heaters, far-infrared radiant heaters, hot plates, heating cable, flexible and molded heaters, controls, hardware, reference literature and technical information. *Edwin L. Wiegand Co.* L-133

Centralized Motor Starters. The advantages of centralizing motor starters in control panels are discussed in a new four-page technical bulletin. Savings in initial costs, wiring, engineering time, and reduced maintenance costs are detailed. Six photographs of motor starter centers mounted in control panels at various manufacturing plants are used to illustrate the brochure. *Richardson Scale Co.* L-134

Accessories for Microscopy. This is a 32 page catalog which describes the accessories available by the company for the entire microscope field. The many items described and illustrated are both useful and essential to one who is concerned with the field of electron microscopy. *Ernest F. Fullam, Inc.* L-135

Adhesives and Coatings. A 16 page booklet provides information on the company's line of adhesives and coatings including color, wet weight, temperature range, flammability, applications, coverages, drying time and thinners. *Insul-Coustic Corp.* L-136

FOR MORE INFORMATION on the trade literature reviewed here, use the Reader's Service Card elsewhere in this issue.

CLASSIFIED ADVERTISING

Rates: All Classifications except Positions Wanted:

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TOP-NOTCH ADHESIVE CHEMIST. Thoroughly experienced supervising and performing development, production, control, technical service on starch, dextrin, polyvinyl, resin, gum, animal glue, casein, natural and synthetic latex adhesives. Will expand and improve your adhesives and keep your salesmen and customers happy. Address Box A-124-P, ADHESIVES AGE.

HELP WANTED

ADHESIVE CHEMIST

Excellent opportunity for young man with college degree in chemistry. Experience in Rubber, Resin and P. V. A. essential. Position located in Mid-West with growing national adhesive company. Send confidential resume, salary requirement, personal data in first letter. Address Box A-123-W, ADHESIVES AGE.

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5 or more years experience in latex compounding or with latex or resin based adhesives. Technical service and product development work with expanding medium-sized N.J. chemical company.
Excellent compensation and fringe benefits. Send detailed resume and salary requirements. Replies held in confidence. Address Box A-125-W, ADHESIVES AGE.

CHEMIST OR FORMULATOR OF STRUCTURAL ADHESIVES

Responsibilities—to plan, supervise and carry out assignments in the development and testing of structural adhesives based on resins and rubbers for the practical industrial assembly of dissimilar structural materials, to originate ideas and solutions to problems arising from field contacts.

Qualifications—Degree in polymer chemistry preferred and a practical formulating experience in epoxies, phenolics, polyesters, isocyanates, rubbers, etc.

Location—Northeastern Ohio.

Benefits—Above average programs now in effect.

Salary—Dependent upon qualifications, up to $8,500. Replies to include complete personal history, academic background, industrial experiences, positions, and responsibilities, motivation for changes, salaries, references and avocations.

CHAMBERLAIN LABORATORIES
P.O. Box 624, Stow, Ohio
Attention: Director

HELP WANTED-CONTINUED

CHEMICAL ENGINEER
OR
CHEMIST

Chemical Engineer or chemist, technical service for manufacturer of adhesives, sealants and protective coatings for Thermal Insulation. Job includes liaison between development lab and sales department, laboratory investigation of service problems, field contacts and trouble-shooting. Calm disposition, tact and mature judgment are essential. Write giving details to:

F. E. WILSON
BENJAMIN FOSTER CO.
Ambler, Pa.

ADHESIVES CHEMIST

. . . to develop new types of cements for industry. Must be familiar with formulation of rubber, resinous and polymeric adhesives, including latex, solvent and hot-melt types. New, well-equipped laboratory of old established company offers excellent facilities, suburban location and contact with talented associates. Write giving details to:

F. E. WILSON
BENJAMIN FOSTER CO.
Ambler, Penna.

BUSINESS OPPORTUNITIES

Materials Offered. PLASTICIZERS. Dibutyl Phthalate, fresh stock, 10 drums, 42O¢ net each, low price. Acetyl Tributyl Citrate, 20 drums, price slashed to clear inventory. Also new Secondary Plasticizer CA-404, for vinyl or rubber, low volatility, excellent compatibility, stability, etc., low price, drums or bulk. CHEMICAL AFFILIATES, Inc., 274 Madison Ave., New York 16, N.Y. MU3-2593.

EQUIPMENT FOR SALE

$3,000,000 LIQUIDATION CHEMICAL PLANT AT ORANGE, TEXAS. Type 316 Stainless Steel Tanks, Kettles, Heat Exchangers, Columns, Stills, Crystallizers, Centrifugals, Pumps, Valves etc. WONDERFUL VALUES. SEND FOR LIST. PERRY EQUIPMENT CORP., 1414 N. 6th St., Philadelphia 22, Penna.

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Lesser Evil?

Addiction to nicotine, a widespread weakness accompanied by a serious fire hazard and possible ingestion of tars, is one of industry's serious problems. *National Safety News* notes that on many operations, smoking on the job can't be permitted, so employees feeling the craving spend too much time in rest rooms. An enterprising tobacco salesman had a bright idea. At a box factory he arranged with the shop foreman and union representatives to provide regular supplies of chewing tobacco and snuff. Now, the men can enjoy their usual solace at work without the danger of burning down the plant and their jobs.

Reports claim the company has gained more than a hundred working hours a month since the men switched to smokeless tobacco. They no longer take so many washroom and smoking breaks. Next, the salesman called on a cannery with equally satisfactory results in sales for his company and increased production for the customer. This quick and easy change of vices has lead *National Safety News* to wonder whether the salesman would have had as much luck with a working force largely female.

Any Gum Chum?

Americans chewed their way through 250 million pounds of gum last year according to a recent issue of *Industrial and Engineering Chemistry*. This represents more than 200 sticks per person. Into the 250 million pounds of gum went 150 million pounds of sugar, 50 million pounds of corn syrup, 24 million pounds of synthetic rubber and resins and 20 million pounds of natural materials such as chicle. Total sales of chewing gum in the United States came to $306 million last year. Gum manufacturers are aiming at an eventual annual consumption of 500 sticks per person.

On The Shelf

The *Wall Street Journal* reports that P. Lorillard Co. has begun paying stores "rentals" of from $5 to $10 per month on an annual basis for eye-level shelf position spots. One of the largest food chains reportedly has signed up and two more are said to be interested. Other cigarette manufacturers are reported to be rushing their own "incentives" to food stores to counteract the Lorillard offer.

Twistalk

Recently, *Parade* magazine coined a new word, "twistalk," to describe the language everyone uses in work and social situations. This language is polite or expected, but it masks what you really are thinking. Some examples of "twistalk" include:

Expedite—To confuse confusion with emotion.

Coordinator—The guy who has his desk between two expediters..

Under Consideration—Never heard of it.

Under Active Consideration—We're looking in the files for it.

Note and Initial—Let's spread the responsibility for this.

Let's Get Together On This—I'm assuming you are as confused as I am.

Have You Any Remarks—Can you give me any idea what this is all about?

This Will Be Borne In Mind—No further action will be taken until you remind me.

In Due Course—Never.

Trademark Value

The value of a trademark is appreciated on the other side of the Iron Curtain. In Poland, for example, trademarks are treated as rewards. Gerald Frisch of Jim Nash Associates reports that in Poland, the government permits trademarks only on packages of products that meet a particularly high standard. On the other hand, factories that fail to rate this seal of approval are severely handicapped. A Polish newspaper has been known to complain that "whole branches of our industry are either anonymous or unknown."

Consumer Department

A new U.S. Department of Consumers, with a cabinet member at its head, is the aim of Senator Kefauver and 23 other senators. The proposed department would keep its eye on prices, investigate complaints of misrepresentation, etc., and would take over existing agencies in the food, drug, pricing, research and testing fields. It would also hold annual consumer conferences. The proposal is said to have the support of many labor unions, consumer groups and women's organizations. However, Congressional approval is not expected soon.